



When	Date	Entered)
	(When	(When Date

RECOPT NUMBER 2. GOVT ACCESSION NO. RECIPIENT'S CATALOG NUMBER DAEN/NAD 53842/DEGGG28-8G/11	// REPORT DOCUMENTATION PAGE	
S. TYPE of REPORT A PERIOD COVERED Phase I Inspection Report National Dam Safety Program Lake Como Dam Kent County, Delaware 7. Authore) JOHN J. WILLIAMS P.E. S. PERFORMING ORGANIZATION NAME AND ADDRESS O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. Controlling office name and Address U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 Dam (DE 19028), Delivare River Basin, Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of the Report) 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report) 18. AUGUSTA STATEMENT (of the abstract entered in Block 20, 11 different from Report)		OVT ACCESSION NO. 3. RECIPIENT'S CATALOG NUMBER
Phase I Inspection Report National Dam Safety Program Lake Como Dam Kent County, Delaware 7. Author(a) S. Performing organization name and address O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. Controlling office Name and address U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 13. Mumber of Pages Philadelphia, Pennsylvania 19106 14. Munitamina agency name a Addressyl different from Controlling Office) National Dam Safety Program. Lake Como Mill Creek, Kent County, Delaware. 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report)		D: 1046051
National Dam Safety Program Kent County, Delaware 7. Author(s) 9. Performing organization name and address O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. Controlling office name and address U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestmut Streets Philadelphia, Pennsylvania 19106 14. Mountained agency name a address diditional from Controlling Office) National Dam Safety Program. Lake Como Mill Creek, Kent County, Delaware. Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (cl die Report) 17. DISTRIBUTION STATEMENT (cl the abstract entered in Block 20, it different from Report)	4. TITLE (and Subtitle)	5. TYPE OF REPORT & PERIOD COVERED
Lake Como Dam Kent County, Delaware 7. AUTHOR(s) JOHN J. WILLIAMS P.E. 9. PERFORMING ORGANIZATION NAME AND ADDRESS O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 13. MUNITORIA AGENCY NAME & ADDRESS/// different from Controlling Office) National Dam Safety Program. Lake Como Dam (DE 00028), Delaware River Basin, Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of the Report) Approved for public release; distribution unlimited.	Phase I inspection Report	
Rent County, Delaware 7. Author(s) JOHN J. WILLIAMS P.E. 9. PERFORMING ORGANIZATION NAME AND ADDRESS O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 13. Number of Pages Philadelphia, Pennsylvania 19106 14. McMurorning Agency NAME & Address/Il different from Controlling Office) Dam (DE 00028), Delivaere River Basin, Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, it different from Report)	Lake Como Dam	
JOHN J. WILLIAMS, P.E. 9. PERFORMING ORGANIZATION NAME AND ADDRESS O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 14. McWitchina Agency Name & Addressific different from Controlling Office) National Dam Safety Program. Lake Como Mill Creek, Kent County, Delaware. Mill Creek, Kent County, Delaware. 16. DISTRIBUTION STATEMENT (of this Report) 16. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report) 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report)	1	G. PERFORMING ONG. REPORT RUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 13. National Dam Safety Program. Lake Como Mill Creek, Kent County, Delaware. Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of this Report) 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)	7. AUTHOR(a)	8. CONTRACT OR GRANT NUMBER(a)
O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 14. MONITORING AGENCY NAME & ADDRESS(If different from Controlling Office) National Dam Safety Program. Lake Como Mill Creek, Kent County, Delaware River Basin, Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report)	JOHN J. WILLIAMS P.E.	DACW61-80-D-0013/
Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103 11. controlling office name and address U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 14. Monitorina Agency Name & Address(II different from Controlling Office) National Dam Safety Program. Lake Como Mill Creek, Kent County, Delaware. Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report)		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
Philadelphia, PA 19103 11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestmut Streets Philadelphia, Pennsylvania 19106 14. Monitorial Dam Safety Program. Lake Como Dam (DE 00028), Delaware River Basin, Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of the Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report)	Suite 1760	
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 14. MCHITGRING AGENCY NAME & ADDRESS(II different from Controlling Office) National Dam Safety Program. Lake Como Dam (DE \$\partial phi 28\), Deliware River Basin, Phase I Inspection Report. 15. DECLASSIFICATION/DOWNGRADING SCHEDULE 15. DECLASSIFICATION/DOW	-	
U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 14. MCMITARING AGENCY NAME & ADDRESS/II dillerent from Controlling Office) National Dam Safety Program. Lake Como Dam (DE 00028), Delaware River Basin, Phase I Inspection Report. 15. SECURITY CLASS: (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE 17b. DISTRIBUTION STATEMENT (of this Report) 17c. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		112 050007 0475
Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106 14. MCMITCRING AGENCY NAME & ADDRESS(II dilierent from Controlling Office) National Dam Safety Program. Lake Como Dam (DE \$\phi\phi\phi\phi\phi\phi\phi) Delaware River Basin, Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of the Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report)	1	
Philadelphia, Pennsylvania 19106 14. MCMITCRING AGENCY NAME & ADDRESS(if different from Controlling Office) National Dam Safety Program. Lake Como Dam (DE \$\phi\phi\phi\parts) = \text{Delivare River Basin,} \text{Mill Creek, Kent County, Delaware.} Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
Dam (DE 00028), Delivare River Basin, Mill Creek, Kent County, Delaware. Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report)	Philadelphia Denneylyania 10106	
Dam (DE 00028), Delivare River Basin, Mill Creek, Kent County, Delaware. Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, 11 different from Report)	14. MONITORING AGENCY NAME & ADDRESS(If different from	Controlling Office) 15. SECURITY CLASS. (of this report)
Mill Creek, Kent County, Delaware. Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)	/ National Dam Safety Day	_ ^ · · · · · · · · · · · · · · · · · ·
Phase I Inspection Report. 16. DISTRIBUTION STATEMENT (of the Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
16. DISTRIBUTION STATEMENT (of the Report) Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)	The state of the s	15a. DECLASSIFICATION/DOWNGRADING
Approved for public release; distribution unlimited. 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)	Phase I Inspection Report.	SCHEDULE
17. DISTRIBUTION STATEMENT (of the abatract entered in Block 20, if different from Report)	16. DISTRIBUTION STATEMENT (of this Report)	
	Approved for public release; distribu	tion unlimited.
	17. DISTRIBUTION STATEMENT (of the abstract entered in Blo	ock 20, if different from Report)
18. SUPPLEMENTARY NOTES		
	18. SUPPLEMENTARY NOTES	
Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.	Copies are obtainable from National Te Virginia, 22151.	chnical Information Service, Springfield,
19. KEY WORDS (Cantinue on reverse side if necessary and identify by block number)	19. KEY WORDS (Continue on reverse side if necessary and iden	ntify by block number)
Dams National Dam Safety Program Embankments Lake Como Dam, DE		- · · · · · · · · · · · · · · · · · · ·

Visual Inspection

Spillways

Structural Analysis

20. ABSTRACT (Continue on reverse side if necessary and identity by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered)

NOTICE

THIS DOCUMENT HAS BEEN REPRODUCED FROM THE BEST COPY FURNISHED US BY THE SPONSORING AGENCY. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE.



NAPEN-N

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106



LIVE

17 FEB 1961

Honorable Pierre S. DuPont Governor of Delaware Dover, Delaware 19901



Dear Governor DuPont:

Inclosed is the Phase I Inspection Report for Lake Como Dam in Kent County, Delaware which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Lake Como Dam, a significant hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered inadequate since nine percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. (The SDF, in this instance, is one-half of the Probable Maximum Flood.) The dam's stability is considered questionable by personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. To ensure adequacy of the structure, the following actions, as a minimum are recommended:

- a. Within thirty days from the date of approval of this report, the following remedial actions should be initiated:
- (1) Ownership of and maintenance responsibility for the dam should be clarified.
- (2) A registered professional engineer experienced in the design and construction of dams should be engaged by the owner to:
- (a) Perform more detailed hydrologic and hydraulic analysis to determine what measures are required to provide adequate spillway discharge capacity and/or to protect the embankment from overtopping.

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

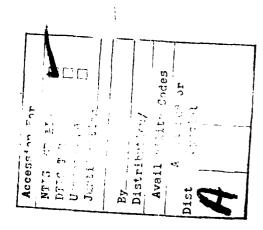
NAPEN-N

Honorable Pierre S. Dupont

- (b) Design and supervise construction of repairs to the existing embankment section.
- (c) Design and supervise the construction of erosin protection for the upstream and downstream slopes of the dam and outlet channel.
- (d) Provide guidance to the owner for removal of the trees and utility poles from the embankment and the backfilling of voids with suitable, thoroughly compacted material.
- (e) Provide guidance to the owner for removal of the water and gas lines from the dam and their relocation.
- b. The owner should maintain the reservoir elevation 3 feet below the spillway crest until permanent repairs are completed.
- c. Continuous monitoring of reservoir levels during periods of heavy precipitation should be undertaken until permanent repairs are completed.
- d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the reconstructed facilities, within one year from the date of their completion.
- e. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency at the dam within six months from the date of approvel of this report.

A copy of the report is being furnished to Mr. John E. Wilson III, Delaware Department of Natural Resources and Environmental Control, the designated State Office contact for this Program. Within five days of the date of this letter, a copy will also be sent to Congressman Thomas B. Evans. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.



NAPEN-N Honorable Pierre S. Dupont

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

1 Incl As stated JAMES G. TON Colonel, Corps of Engineers District Engineer

Copies Furnished:
Mr. John E. Wilson III, Acting Secretary
Department of Natural Resources and
Environmental Control
Edward Tatnall Bldg.
Dover, DE 19901

Mr. Melvin H. Koster, Acting Director Division of Soil & Water Conservation Department of Natural Resources and Environmental Control Dover, DE 19901

Rept. mo. DAEN | NAP - 53842 | DE 00028 - 80/11

LAKE COMO DAM (DE00028)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 12 August 1980 by Corps and State personnel and by O'Brien and Gere Engineers, Inc., under contract to the U.S. Army Engineer Distict, Philadelphia, in accordance with the National Dam Inspection Act, Public Law 92-367.

The inspection of Lake Como Dam was requested by the State of Delaware in response to its overtopping on 29 July 1980. As a result of this inspection, Lake Como Dam, is judged to be in an UNSAFE, non-emergency condition until corrective measures are completed. This condition, erosion and partial failure of the downstream half of the embankment and the east outlet channel slope, if left uncorrected, could result in complete failure of the dam and further property damage. Until further study could determine the full extent of the problem and possible permanent corrective actions, immediate remedial recommendations were made to preclude further property damage. The Governor and his representative and the Delaware Division of Highways were notified of this condition and the recommended immediate remedial actions by telegram on 19 August 1980. (Also, a teletype report was submitted to the U.S. Army Engineer Division, North Atlantic, on 29 July 1980.) The representative of the town of Smyrna indicated that the lake will be maintained in a drawn down condition until corrective measures are completed.

Lake Como Dam, a significant hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered inadequate since nine percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. (The SDF, in this instance, is one-half of the Probable Maximum Flood.) The dam's stability is considered questionable by personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. To ensure adequacy of the structure, the following actions, as a minimum are recommended:

- a. Within thirty days from the date of approval of this report, the following remedial actions should be initiated:
- (1) Ownership of and maintenance responsibility for the dam should be clarified.
- (2) A registered professional engineer experienced in the design and construction of dams should be engaged by the owner to:
- (a) Perform more detailed hydrologic and hydraulic analysis to determine what measures are required to provide adequate spillway discharge capacity and/or to protect the embankment from overtopping.

- (b) Design and supervise construction of repairs to the existing embankment section.
- (c) Design and supervise the construction of erosin protection for the upstream and downstream slopes of the dam and outlet channel.
- (d) Provide guidance to the owner for removal of the trees and utility poles from the embankment and the backfilling of voids with suitable, thoroughly compacted material.
- (e) Provide guidance to the owner for removal of the water and gas lines from the dam and their relocation.
- b. The owner should maintain the reservoir elevation 3 feet below the spillway crest until permanent repairs are completed.
- c. Continuous monitoring of reservoir levels during periods of heavy precipitation should be undertaken until permanent repairs are completed.
- d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the reconstructed facilities, within one year from the date of their completion.
- e. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency at the dam within six months from the date of approvel of this report.

APPROVED:

JAMES G. TON

Colonel, Corps of Engineers

District Engineer

DATE:

17 Feb 1981

NATIONAL PROGRAM OF INSPECTION OF DAMS UNSAFE DAM

NAME: Lake Como Dam

b. ID NO.: DE00028

Delaware. County: LOCATION State:

Kent.

HEIGHT: 12 feet

MAXIMUM IMPOUNDMENT

River or Stream: Mill Creek.

Roadway Embankment. TYPE:

CAPACITY: 312 ac. ft.

Smyrna. Nearest D/S City or Town: Division of Highways appear to have joint ownership.

OWNER: Unknown, Town of Smyrna and Delaware

•

LATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 19 Aug 80.

CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT: Dam was overtopped and suffered severe erosion downstream embankment and outlet channel. ٠.; URGENCY CATEGORY: UNSAFE, Non-Emergency, Significant Hazard.

Embankment was sandbagged by local volunteers to prevent EMERGENCY ACTIONS TAKEN:

potential. Overtopping and failure of the dam poses Significant Hazard significant hazard potential to loss of life and property downstream of dam at Route 13 Highway Bridge, small private luncheonette and sewage DESCRIPTION OF DANGER INVOLVED:

further erosion.

REMEDIAL ACTIONS TAKEN:

ė

ċ

pumping plant.

RECOMMENDATIONS GIVEN TO GOVERNOR:

:

REMARKS: Delaware Highway Department is undertaking repair to the structure to reopen Main Street.

Lake was drawn down until remedial measures are completed.

etter, the owner should do the following:

Within 30 days of the date of the District Engineer's

(1) Lower the lake level three feet.

consultant to more accurately determine the spillway Engage the services of a qualified professional

any remedial measures required to prevent overtopping hydrologic and hydraulic analyses, and to recommens adequacy by using more detailed and sophisticated

of the dam.

Develop a detailed emergency operation plan and downstream warning system. Provide around the clock surveillance during periods of unusually heavy precipitation.

Monitor the dam and inspect for additional seepage or sloughing.

Make soil borings and a topo-survey.

Relocated gas and water lines from the embankment Design an adequate embankment section.

T.B. HEVERIN, Coordinator Dam Inspection Program

. .

DELAWARE RIVER BASIN

NAME OF DAM: LAKE COMO DAM COUNTY AND STATE: KENT, DELAWARE INVENTORY NUMBER: DE00028

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

Prepared by: O'BRIEN & GERE ENGINEERS, INC.

For

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Custom House - 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

Name of Dam: State Located: County Located: Stream: Coordinates: Date of Inspection:

Lake Como Dam ID#DE00028
Delaware
Kent
Mill Creek
Latitude 390 17.81, Longitude 750 361
August 12, 1980

ASSESSMENT

Based on visual observations made during the inspection (which followed overtopping and partial failure of the dam on July 29, 1980), information provided by the Town of Smyrna, and conversations with town officials, Lake Como Dam is considered to be in poor overall condition.

The dam is an earth embankment approximately 240 feet long with a maximum height of about 12 feet. The top width of the dam is about 60 feet and the upstream and downstream slopes are relatively steep. The spillway consists of five circular drop inlets, each with a diameter of 27 inches, which provide about 3 feet of freeboard between the spillway crest and the top of the dam.

The downstream half of the embankment eroded away by as much as five feet when the dam was overtopped on July 29, 1980. One section of the failure zone extends nearly through the embankment and has been backfilled with sandbags. A large section of the east outlet channel slope was also eroded away. A ruptured gas line and a water main were exposed in the erosion zone. Small trees were growing on the embankment and utility poles have been installed on the dam.

The selected Spillway Design Flood (SDF) for this "Small" size, "Significant" hazard dam is one-half of the Probable Maximum Flood (PMF). Examination of the results of the hydrologic and hydraulic analyses indicates that the spillway is capable of discharging approximately 8 percent of the SDF prior to overtopping of the embankment. Failure of the dam would cause appreciable property damage downstream. Therefore, the spillway is classified as "Inadequate", and the dam is classified as "Unsafe, non-emergency".

Recommendations and remedial measures which should be initiated immediately are as follows:

a. Facilities

1. Ownership and maintenance responsibility for the dam should be clarified.

A registered professional engineer experienced in the design and construction of dams should be engaged to:

- 1. Perform detailed hydrologic and hydraulic analyses to determine what measures are required to provide adequate spillway discharge capacity and/or to protect the embankment from overtopping.
- 2. Design and supervise construction of repairs to the existing embankment section.
- 3. Design and supervise the construction of erosion protection for the upstream and downstream slopes of the dam and outlet channel.
- 4. Provide guidance to the Owner for the removal of trees and utility poles from the embankment and backfilling of voids with suitable, thoroughly compacted material.
- 5. Provide guidance to the Owner for the removal of water and gas lines from the dam and their relocation.

b. Operation and Maintenance Procedures

- 1. The Owner should maintain the reservoir elevation 3 feet below the spillway crest until permanent repairs are completed.
- 2. Continuous monitoring of reservoir levels during periods of heavy precipitation should be underaken until permanent repairs are completed.
- 3. The Owner should employ a professional engineer experienced in operation and maintanance of dams to develop written operating procedures and a periodic maintenance plan to insure the safety of the reconstructed facilities.
- 4. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency.

Date: 2-0 JAN. 1981

No. 2884

iii



UPSTREAM OVERVIEW LOOKING TOWARDS LEFT ABUTMENT (8/12/80)



DOWNSTREAM OVERVIEW SHOWING FAILURE ZONE AND SPILL-WAY OUTLET CONDUIT HEADWALL. (8/12/80)

TABLE OF CONTENTS

	PAGE
Preface Assessment	i ii
SECTION 1 - PROJECT INFORMATION	
1.1 General1.2 Project Description1.3 Pertinent Data	1 1 2
SECTION 2 - ENGINEERING DATA	
2.1 Design2.2 Construction2.3 Operation2.4 Evaluation	4 4 4 4
SECTION 3 - VISUAL INSPECTION	
3.1 Findings	5
SECTION 4 - OPERATIONAL PROCEDURES	
 4.1 Procedures 4.2 Maintenance of Dam 4.3 Maintenance of Operating Facilities 4.4 Description of Any Warning System in Effect 4.5 Evaluation of Operational Adequacy 	6 6 6 6
SECTION 5 - HYDRAULICS AND HYDROLOGY	
5.1 Evaluation of Features	7
SECTION 6 - STRUCTURAL STABILITY	
6.1 Evaluation of Structural Stability	9
SECTION 7 - ASSESSMENT, RECOMMENDATIONS, AND PROPOSED I	REMEDIAL MEASURES
7.1 Dam Assessment 7.2 Recommendations and Proposed Remedial Measures	11 11

TABLE OF CONTENTS (cont.)

APPENDICES

CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION OPERATION, PHASE I CHECKLIST, VISUAL INSPECTION, PHASE I HYDROLOGIC AND HYDRAULIC DATA APPENDIX A -

APPENDIX B -APPENDIX C -

APPENDIX D -**PHOTOGRAPHS** APPENDIX E -**DRAWINGS** APPENDIX F -SITE GEOLOGY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

LAKE COMO DAM

INVENTORY NUMBER - DE 00028

SECTION 1

PROJECT INFORMATION

1.1 General

- a. <u>Authority</u>. This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract #DACW 61-80-D-0013 between O'Brien & Gere Engineers, Inc. and the United States Army Corps of Engineers, Philadelphia District.
- b. <u>Purpose of Inspection</u>. The purpose of this inspection is to evaluate the structural and hydraulic condition of Lake Como Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.
- 1.2 <u>Project Description</u> (Based on information supplied by the Town of Smyrna, DE and supplemented by field observations.)
- a. Description of Dam and Appurtenances. The following is a general description of the dam and appurtenances prior to its overtopping and partial failure on July 29, 1980. A detailed description of the structure after this event is given in Section 3, Visual Inspection. Lake Como Dam is an earth embankment approximately 240 feet long with a maximum height of about 12 feet. The top width of the embankment is about 60 feet and the upstream and downstream slopes are variable, ranging between 2H:1V and 1H:1V. A 30 feet wide asphalt concrete paved street is located along the entire embankment length.

The spillway consists of five 27-inch diameter concrete drop inlets provided with anti-vortex devices. Each drop inlet is connected to a 36-inch diameter reinforced concrete outlet pipe which terminates at a headwall at the downstream toe of the embankment. The outlet works consist of hand operated sluice gates situated upstream of two drop inlet structures. Access to the gate operators is across a timber bridge.

- b. Location. Lake Como Dam is located on Mill Creek in the City of Smyrna, Delaware. The site is shown on USGS Quadrangle entitled "Smyrna, Del." at coordinates N39° 17.8′, W75° 36′. A regional location map of Lake Como Dam is included as Figure 1 in Appendix E.
- c. Size Classification. Lake Comp Dam has a maximum height of 12 feet which places it in the "Small" size dam category since it is less than 40 feet high.

The maximum storage capacity of 312 acre-feet also places the structure within the "Small" size classification (less than 1,000 acre-feet). Lake Como Dam is therefore classified as a "Small" size dam.

- Hazard Classification. A reinforced concrete bridge supporting U.S. Route 13 spans Mill Creek about 110 feet downstream of Lake Como Dam. Both the bridge deck and highway approach elevations are at or near the existing dam crest elevation. A restaurant is located adjacent to the right bank of Mill Creek between the dam and the highway bridge. The ground floor elevation of the restaurant is at the existing dam crest elevation. A sewage pumping station and treatment plant are located immediately downstream of the highway bridge within the potential floodplain. Since failure of the dam could result in appreciable property damage, Lake Como Dam is classified in the "Significant" hazard potential category.
- Ownership. The owner of Lake Como Dam is unknown. According to Mr. Dean Phillips, Assistant Manager, Town of Smyrna, the Town has no record of ownership on file at their offices.
- f. Purpose of Dam. The dam is used for recreation only.
- Design and Construction History. Information is unavailable concerning the original design and construction of the dam. The only drawings made available for this report were those prepared by J.E. Haddaway Engineer dated March, 1941 which were prepared for reconstruction of the dam after its failure in 1940. The original date of construction is unknown.
- Normal Operating Procedures. Records of operating procedures are unavailable for this site.

Pertinent Data

Drainage Area.

	Square Miles	6.8
b.	Discharge at Dam Site (cfs).	
	Spillway Capacity	184
C.	Elevation (Feet above MSL).	
	Spillway Crest (Normal Pool) Top of Dam (Maximum Pool) Streambed at Downstream Toe of Dam	14.6 17.6 6.0
d.	Reservoir Lenath (Feet)	

Reservoir Length (Feet).

Normal Pool	4,400
Maximum Pool	6,000

e. Storage (Acre-Feet).

Normal Pool	138
Maximum Pool	312

f. Reservoir Surface Area (Acres).

Normal Pool	46
Maximum Pool	71

g. Dam Data.

Туре	Earth
Length	240 Feet
Height	12 Feet
Top Width	60 Feet
Side Slopes (Upstream and Downstream)	Variable, 1H:1V Steepest
Zoning	None
Impervious Core	None
Cutoff	None
Grout Curtain	None

h. Spillway.

Type	5 Circular Drop Inlets
Crest Diameter	27 Inches
Crest Elevation	14.6
Outlet Diameter	36 Inches
Outlet Invert Elevation	6.0
Gates	None
Upstream Channel	None
Downstream Channel	Trapezoidal concrete and brick-lined
	channel to R/C bridge to Mill Creek

i. Outlet Works.

Type	2-36 inch diameter concrete pipes
Length	90 Feet
Closure	36"x44" sluice gates
Access	Timber-decked bridge
Regulating Facility	Hand-operated rising stems

ENGINEERING DATA

2.1 Design.

- a. Data Available. Information available for review is limited to drawings entitled "DROP INLET SPILLWAY, LAKE COMO" sheets 1 and 2, dated March, 1941 by J.E. Haddaway Engineer. No design data is available for this structure.
- b. Design Features. The principal design features for this structure are discussed in Section 1.2a.

2.2 Construction.

Information is unavailable relative to the original construction or reconstruction of Lake Como Dam in 1941.

2.3 Operation.

No operational data is available for this site.

2.4 Evaluation.

- a. Availability. All information made available was provided by the Town of Smyrna.
- b. Adequacy. The information made available by the Town of Smyrna, conversations with city officials and observations made during the field investigations provided adequate data for a Phase 1 evaluation.
- c. Validity. The drawings prepared by J.E. Haddaway Engineer are not a valid representation of the present structure. Refer to Section 1.2a for a description of the dam and appurtenances.

VISUAL INSPECTION

3.1 Findings.

- a. General. The field inspection of Lake Como Dam took place on August 12, 1980. At the time of inspection, the reservoir water surface was approximately 15 inches below the spillway crest elevation. No underwater areas were inspected. The observations and comments of the field inspection team are in the checklist which is Appendix B of this report. The emabnkment had experienced overtopping and partial failure on July 29, 1980.
- b. Dam. The overtopping which occured on July 29, 1980, resulted in erosion of about five feet of the downstream half of the embankment. Large sections of the 40-foot wide concrete and asphalt street paving within the failure zone had collapsed and were lying on the embankment fill. The entire downstream slope had been eroded away. One section of the failure zone near the right abutment extended almost to the crest of the upstream slope and was backfilled with sandbags. A six-inch water main and ruptured four-inch diameter gas line were exposed within the dam failure zone. The upstream slope was not damaged even though it is unprotected by riprap or other slope protection. The embankment crest upstream of the street is grass covered except for a sidewalk. Two trees with trunk diameters of about six inches were growing on the dam crest. Two power utility poles have been installed in the dam crest upstream of the sidewalk. No seepage was observed flowing from the failure zone.
- c. Appurtenant Structures. The five circular concrete drop inlets, the wooden access bridge and gate operators for the low-level outlet works were not darnaged during the overtopping failure. The outlet conduits and headwall downstream of the dam were in fair condition. The operators for the low-level outlets were in serviceable condition and were being used to lower the reservoir level. The deck elevation of the access bridge is about 18 inches below the dam crest elevation.
- d. Reservoir Area. The reservoir slopes are very gentle and are grass and tree covered. No indications of slope instability were observed.
- e. <u>Downstream Channel</u>. A large section of the east slope of the stream channel downstream of the headwall between the dam and the highway bridge has been eroded away. The cascading concrete outlet apron extending downstream of the headwall was in good condition. The concrete and brick-lined west channel slope was severely damaged but had not allowed the occurrence of significant erosion.

OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures have been established for Lake Como Dam.

4.2 Maintenance of Dam

The grass on the embankment is cut on a regular basis during the growing season.

4.3 Maintenance of Operating Facilities

The operators for the low-level outlets are maintained in a serviceable condition.

4.4 Description of Any Warning System in Effect

No formal warning system exists for this site.

4.5 Evaluation of Operational Adequacy

A periodic inspection and maintenance program should be implemented and a formal warning system should be established.

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. No hydrologic or hydraulic data was available for review. Lake Como has a drainage area of 6.8 square miles. The spillway at Lake Como Dam has an estimated discharge capacity of 184 cfs.

For further information, refer to the calculations and computer printout included in Appendix C of this report.

- Experience Data. No rainfall or reservoir level records are maintained at this site. The locally heavy rains which caused the overtopping of Lake Como Dam on July 29, 1980, were measured by the U.S. Weather Service to be in excess of 5 inches with 4 inches falling between 5:00 and 6:00 a.m. According to local newspapers, floodwaters overtopped the dam by as much as 4 feet and the total precipitation was reported as 7 inches. A letter dated August 15, 1980, from the Delaware Geological Survey to the Delaware Department of Transportation stated that preliminary calculations performed by the United States Geological Survey indicate a peak discharge of 1,250 cubic feet per second (cfs) in Mill Creek upstream of Lake Como. The peak flow downstream of the dam was computed to be about 2,520 cfs (a copy of the letter is included in Appendix E). Inspection of the dam after the overtopping indicated that the high water marks were about two feet above the dam crest. The embankment also collapsed in 1940 and was overtopped in 1913 according to town officials. Unverified accounts indicate that the dam has been overtopped on several occasions since its 1941 reconstruction. Further details concerning these events are unavailable.
- c. <u>Visual Observations</u>. On the date of inspection the reservoir pool was about 15 inches below the spillway crest. The low level outlets were partially open allowing about 2 cfs to discharge into Mill Creek.
- d. Overtopping Potential. The recommended Spillway Design Flood (SDF) range for a "Small" size, "Significant" hazard dam is from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Since disruption of a major highway, a sewage treatment plant and pumping station caused by a dam failure would have a significant effect upon the community, the selected SDF is one-half of the PMF. The SDF was synthesized from one-half of the Probable Maximum Precipitation (PMP) using the SCS unit hydrograph for Lake Como. The inflow hydrograph was routed through Lake Como with the initial water surface elevation at the spillway crest. The peak inflow and outflow rates for the SDF were computed to be 6620 cfs and 6568 cfs, respectively. The spillway is capable of discharging approximately 8 percent of the SDF prior to overtopping of the embankment (refer to Appendix C for computations and the computer printout).
- e. Spillway Adequacy. The Lake Como Dam spillway is incapable of passing one-half of the PMF and the dam is classified as a "Significant" hazard structure. Therefore, the Lake Como Dam spillway is classified as "Inadequate".

The two gated 36-inch diameter low-level conduits are capable of draining the normal pool storage capacity to Elevation 6.2 within about 15 hours.

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. <u>Visual Observations</u>. It is evident from the overtopping and partial failure of the embankment on July 29, 1980, that Lake Como Dam cannot withstand significant overtopping for an extended period of time. Leakage or rupture of the water main if left within the embankment could cause piping of sand and fine-grained soil from the dam. The unprotected upstream slope exposes the dam to erosion by wave action. The trees and utility poles in the embankment present potential hazards to the structural integrity of the dam. The root systems of the trees create seepage paths through the embankment. Dislodging of the trees or utility poles during severe wind conditions could remove portions of the embankment.
- b. Design and Construction Data. No construction data is available. The design data is limited to two drawings prepared for reconstruction of the dam in 1941.
 - c. Operating Records. No operating records are maintained at this site.
- d. Post Construction Changes. There are no records of post construction changes. Representatives of the Delaware Department of Natural Resources and Environmental Control, the Army Corps of Engineers and O'Brien & Gere inspected Lake Como Dam following the July 29, 1980 overtopping, and the following "immediate remedial actions" were recommended (copy of the teletype letter from the Corps of Engineers to DE Governor DuPont is included on pages 8 and 9 of Appendix E):
 - 1. Gas lines and water lines should be removed from the embankment and relocated.
 - A professional engineer, experienced in the design and construction of dams, should be engaged to design an adequate spillway and embankment section for the dam.
 - 3. Borings should be taken through the embankment and foundation to determine soil types, in-place densities and other soil properties.
 - 4. A detailed topographic survey of the embankment from the upstream slope to the Highway 13 bridge should be made.
 - 5. The reservoir should be maintained 3 feet below the crest of the spillway pipe risers until permanent repairs have been made.
 - 6. The embankment should be inspected periodically by an experienced engineer for signs of seepage or additional sloughing until permanent repairs are made.

- 7. Until permanent repairs are completed, continuous monitoring of the lake levels should be made during periods of heavy rainfall so that increases in the lake levels can be minimized.
- e. <u>Seismic Stability</u>. Lake Como Dam is in a state of partial failure and its stability under static loading conditions is uncertain. Therefore, an accurate assessment of Lake Como Dam for earthquake loading conditions is not possible.

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. <u>Safety</u>. The visual observations and review of available information indicate that Lake Como Dam is in poor condition. The deficiencies and problem areas noted in Sections 3.1B, 3.1c, 5.1b, 5.1e, and 6.1a indicate an inadequate original design.

The selected SDF for this structure is one-half of the PMF. The spillway is capable of discharging approximately 8 percent of the SDF prior to overtopping of the embankment. The dam is classified as a "Significant" hazard structure since failure would cause appreciable property damage. The spillway is classified as "Inadequate", and the dam is classified as "Unsafe, non-emergency".

- b. Adequacy of Information. The information provided by the Town of Smyrna, conversations with town officials and observations made during the field investigations provided adequate data for a Phase 1 evaluation.
- c. Urgency. The recommendations and remedial measures described in Section 7.2 should be initiated immediately.
- d. Necessity for Further Evaluation. Further investigations should be performed in accordance with Section 7.2, Item 1.

7.2 Recommendations and Proposed Remedial Measures

a. Facilities

1. Ownership of and maintenance responsibility for the dam should be clarified.

A registered professional engineer experienced in the design and construction of dams should be engaged to:

- 1. Perform detailed hydrologic and hydraulic analyses to determine what measures are required to provide adequate spillway discharge capacity and/or to protect the embankment from overtopping.
- 2. Design and supervise construction of repairs to the existing embankment section.
- 3. Design and supervise the construction of erosion protection for the upstream and downstream slopes of the dam and outlet channel.
- 4. Provide guidance to the Owner for removal of the trees and utility poles from the embankment and the backfilling of voids with suitable, thoroughly compacted material.

5. Provide guidance to the Owner for removal of the water and gas lines from the dam and their relocation.

b. Operation and Maintenance Procedures.

- 1. The Owner should maintain the reservoir elevation 3 feet below the spillway crest until permanent repairs are completed.
- 2. Continuous monitoring of reservoir levels during periods of heavy precipitation should be undertaken until permanent repairs are completed.
- 3. The Owner should employ a professional engineer experienced in operation and maintenance of dams to develop written operating procedures and a periodic maintenance plan to insure the safety of the reconstructed facilities.
- 4. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency.

APPENDIX

Α

Check List Engineering Data Design, Construction, Operation Phase I CHECK LIST VISUAL INSPECTION PHASE I

Sheet 1 of 7

National ID # DEGGG28	6.3 M.S.L.		
nt State <u>Delaware</u> Hazard Category <u>Significant</u> loudy Temperature 85 ⁰	Tailwater at Time of Inspection 6.3 M.S.L.	Steve Snider	
County Kent Hazard Catego Weather Partly Cloudy		Lee DeHeer	
Name Dam Lake Como Dam Type of Dam Earth Date(s) Inspection 8/12/80 Wea	Pool Elevation at Time of Inspection 13.3 M.S.L.	Inspection Personnel: John J. Williams	

Remarks: Mr. Brian Heverin and Mr. Brian Mulvenna, Phila. Corps of Engineers, Mr. Krishna Patel, DE Dept. of Natural Resources and Environmental Control and Mr. Harry Odren, City Manager, City of Smyrna were also present. A complete list of attendees during the visual inspection is included on Sheet Ia.

Recorder

S.H. Snider

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

HEFERENCE OR OFFICE STMBOL

SUBJECT

NAPEN

Trip Report of Phase I Inspection of Lake Como Dam and meeting with Delaware D.O.T.

70 Files

FROM

Chief Gen. Des. Sec. DATE 18 August 1980 CMT 1

18 August 1980 CMT 1 MULVENNA/ja/4756

- 1. The undersigned and Brian Mulvenna, General Design Section, travelled to Smyrna, Delaware on 12 August 1980 to meet with representatives of the Delaware Department of Natural Resources, the Delaware Department of Transportation and the City of Smyrna and conduct a Phase I inspection of the Lake Como Dam which was overtopped on 28 July 1980. This inspection was requested by the State in a letter dated August 1980.
- 2. Following is a list of those present during the inspection of Lake Como Dam:

NAME

REPRESENTING

Brian Heverin USACE Brian Mulvenna USACE O'Brien & Gere Lee Deheer Jay Williams O'Brien & Gere Krishna Patel DDNR & EC Darwin Kates Del. D.O.T. Cary Homewookd Del. D.O.T. Jim Moore Del. D.O.T. Paul Martin Del. D.O.T. James W. Simpson Del. D.O.T. Del. D.O.T. Charles Bostick Thomas N. Jarman Town of Smyrna Harry M. Odren Town of Smyrna Councilman - Smyrna Skip Rebar Dean Phillips Asst. Mgr. Smyrna O'BRIEN & GERE

- STEVE SAIDER

 O'BRIEN & GERE

 3. Upon completion of the visual inspection of the dam, discussion ensued with officials of the City of Smyrna and the Delaware Department of Transportation regarding possible courses of action for repair of the dam and any recommendations the Corps may have regarding what repairs should be undertaken. The State and City officials also asked if the Corps could fund the repairs and a negative reply was furnished.
- 4. It was also reported to the state and local officials that the Corps' consultant, O'Brien & Gere, would develop some interim technical recommendations for repair once they have reviewed the existing data on the dam and conducted some preliminary hydrological calculations. These recommendations are expected to be ready approximately one week from the inspection date.

DA :::.. 2496

REPLACES DD FORM 96, WHICH IS OBSOLETE.

Sheet 2 of 7

		Sheet 2 of 7
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Surface cracks were evident around the periphery of the failure zone.	Repair Embankment
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	The downstream toe had been entirely washed away.	Repair Embankment
SLOUGHING OR EROSION OF EMBAHKNENT AND ABUTMENT SLOPES	The entire half of the downstream slope was eroded away.	Repair Embankment
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The embankment crest had been reduced by as much as five feet in some locations.	Repair Embankment
RIPRAP FAILURES	No riprap	Provide erosion protection

Sheet 3 of 7 REMARKS OR RECOMMENDATIONS	This area should be repaired along with embankment.		
OBSERVATIONS	Hydraulic erosion extends into the left abutment	None observed	None
VISUAL EXAMINATION OF	JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	ANY NOTICEABLE SEEPAGE	STAFF GAGE AND RECORDER

DRAINS

None

OUTLET WORKS

	None	EMERGENCY GATE
y Repair and provide slope protection.	The right channel slope entirely eroded away.	OUTLET CHANNEL
	No problems observed	OUTLET STRUCTURE
Access bridge below dam crest elevation limits access during high reservoir stages.	No problems observed	INTAKE STRUCTURE
	None observed	CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT
REMARKS OR RECOMMENDATIONS	OBSERVATIOMS	VISUAL EXAMINATION OF

UNGATED SPILLWAY

		Sheet 5 of 7
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	5 circular drop inlets	Insufficient discharge ca- pacity.
APPROACH CHANNEL	NONE	·
DISCHARGE CHAMMEL	An R/C bridge carrying U. S. route 13 is located 110 feet d/s of dam. Span is about 40 feet and vertical opening about 9 feet.	

NOT APPLICABLE

BRIDGE AND PIERS

RESERVOIR

Sheet 6 of 7

VISUAL EXAMINATION OF	OBSERVAT10MS	REMARKS OR RECOMMENDATIONS
SLOPES .	Very gently sloping grass and forest covered. No indications of instability.	
SEDIMENTATION	None observed.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF COMDITION (OBSTRUCTIONS, DEBRIS, ETC.)	OBSERVATIONS Beyond the Rt. 13 bridge the channel opens into a wide flat flood plain.	REMARKS OR RECOMMENDATIONS
SLOPES	Channel slope is less than 1% to confluence with Smyrna River	·

APPROXIMATE NO. OF HOMES AND POPULATION

No homes downstream of dam. A restaurant and sewage pump station are within the potential floodplain. APPENDIX

В

Checklist Visual Inspection Phase I

.

CHECK LIST ENGINEERING DATA DESIGH, CONSTRUCTION, OPERATION PHASE I

NAME OF DAM L. Como Dam

OI

DE 00028

ITEM

AS-BUILT DRAWINGS

REMARKS

NONE AVAILABLE

Sheet 1 of 4

REGIONAL VICINITY MAP

Refer to Appendix E, Fig. 1

CONSTRUCTION HISTORY

Original date of construction unknown. Dam reconstructed in 1941 after washout.

TYPICAL SECTIONS OF DAM

Refer to Appendix E.

OUTLETS - PLAN

~

DETAILS

Refer to Appendix E.

DISCHARGE RATINGS

CONSTRAINTS

NONE AVAILABLE

RAINFALL/RESERVOIR RECORDS

NONE AVAILABLE

ITEM	Sheet 3 of 4
MONITORING SYSTEMS	None
M001F1CAT104S	The dam was rebuilt in 1941 after a collapse during overtopping in 1940. The dam reportedly failed earlier in the century, but no documentation is available.
HIGH POOL RECORDS	Numerous overtoppings have occurred. Details are unavailable.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	The dam failed in 1940 and sometime between 1913 and 1940.
I'A IHTE!ANCE OPERAT ION RECORDS	None available.

APPENDIX

С

Hydrologic & Hydraulic Data



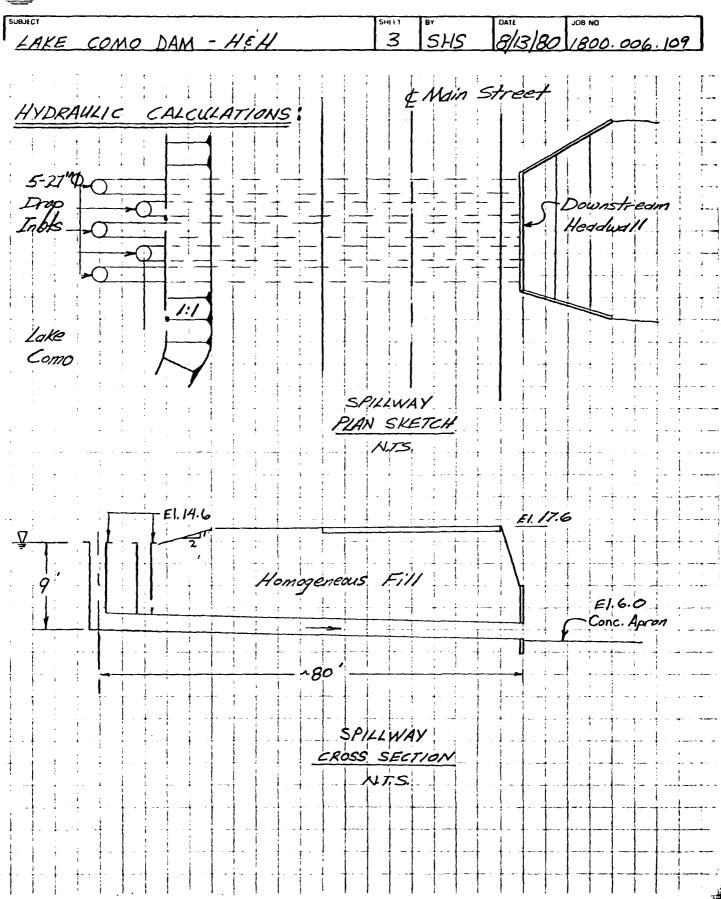
LAKE COMO DAM	SHEET	BY	DATE	JOB NO	
APPENDIX C	```				
HYDROLOGIC & HYDR	AULI	C DA	<u>TA</u>		
TABLE OF CONTE	NTS				
		··			
			S/	heet No.	
PMP Calculations, Reservoir					
Unit Hydrograph & Lag Time (Calcu	lations	3	1-2	
Spillway Plan & Section Sket	tches			3	
Discharge Calculations				4	
HEC-1 Dam Safety Version (Compu	ter Pr	intout	5-29	, <u>.</u>

AKE COMO DAM - HEH	SHEET BY DATE JUB NO 1 SHS 8/13/80 1800.006.109
HYDROLOGIC CALCULATIONS	
Dan 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
Drainage Area - 6.8 sq.mi. (Phi	numeterad from USOS (Juda Sheets)
Reservoir Surface Area:	Storage By HEC-1 Program:
Normal Pool - El. 14.6 =	46 acres 138 acre-feet
Top of Dam - El. 17.6 =	71 scres 3/2 dore-foot
E1. 22.6	= 124 acres 794 acre-fact
PMP COMPUTATIONS: HMR	33
Watershed is in Zone 6 of	
. VVarershed is in Lone & of	THIP ALL SEASON ENVELOPE
24 hr., 200 sq.mi. RAINFAL	L = 24 inches
HR. %	Bainfall
-HR - 70	
6 /13	27.1"
12 124 24 132	29.8" 31.7"
48 142	34.1"
SCS UNIT HYDROGRAPH:	Log Time
The upper 8,000 ft. of dro to be overland flow.	unage basin is considered
Travel Time = 8000	120.4 fps. (SCS Upland Method)
	Cu Historial)
= 5.6 h	rs.



SUBJECT	.			SHEET BY	DATE (A)	JOB NO
LAKE	COMO DAN	1-484		2 SHS	8/13/80	1800.006.109
		The state of the s			• • • •	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
	The romai	inder of I	الم مدير	o Stano	1 / / /	autina
	a walaa L	nder of I	المرام الما	and - Kann	1 - Yam	foribling
	a velocit	y 20300 4p	an order	age Enanne	Charac	101134163
	using NIC	inning's Equ.	etion.		5-13	10-12
. !					1 1 1	9000
			- /	1=0.040	5 1	0.002 ft/ff
			5	A = 500 11		
	L	700		Up ≈ 201		
					_	
				R = 2.49		
		V = 1.49 R 3/3 S	sk = 12	19 (2119)	0.5	
		<u></u>	7, 7,	7 (2141)	<u></u>	-
			0.04		1	
		11-010				
*		V = 3.1 fps	.			+
	•					-
·· ·		1	4. 4			
, ,	Channel	Length = 22,	200 Ff.			
: . :						
•		Trovel 1	ine = 2	2,000 =	2.0 hrs	
				18600)		
1 1		· /-	7 6 104	irs. = 5.6	+2.0	
		- 2				
			017	-1151		
		6 2 29 -	0.6%	=4.5 hrs.		
;						
•						
- 4				-		
			- 1.		1 1 1 -	
			1			
-1			+			
+					-	 -
					1 1	1







SUBJECT	SHEET	BY	DATE	JOB NO
LAKE COMO DAM - HEH	4	SHS	8/13/80	1800.006.109
			7 ——	

Discharge through a "morning-glory" spillway can be calculated by dividing the stage-discharge relationship into two segments as follows: Ref. DESIGN OF SMALL DAMS

1. Weir Crest Control: Q= CLH #2 L=5712.25

Although orifice control is present, the weir coefficient can be adjusted using this eqn. to obtain Q.

= 35.3**′**

2 *Orifice Control: Q= CA VZgH <=
Does not begin until after dam over topping.
*Assume free discharge at spillway outlet.

Discharge over the dam can be described by: Q= CLH3 ; C= 2.8

Dam Length-240', Right Abutment & Same EL. - 260' . L= 500'

STAGE - DISCHARGE TABULATION

W.S.E. (MSL)	Mespillway	C _w	eir 9	Orifi H	ce	H	Dam!	(cfg) ≤ Q
14.6 15.1 15.6 16.6 17.6 18.1 18.6 19.6 20.6 21.6	0 0.5 0.0 2.0 3.5 4.0 5.0 7.0 8.0	3.2 2.8 1.6 1.0 1.0	40 99 160 184 231 283	13.0 15.0 16.0	288 299 309 319	01.000000000000000000000000000000000000	195 1400 3960 7275 11,200 15,652	0 40 99 160 184 726 1683 4248 7574 11,509 15,971

•			
FLOOD HYDROGHAPH PAL DAA SAFETY VEUSIUH LAST HODIFICATION	FLOOD HYDROUMAPH MACKAUE (HEC-1) DA4 SAFETY VEUSIUM LAST HODIFICATION AS FEW 79		
		NATIONAL UMM INSPECTION PROGRAM	
~ ~ *	0 000 EA	LAKE COMO DAM HYDHULOGIC AMALYSIS 10 0 0 0 0	-3 0
v & L	ر - 0 - 50	1	1.0
x 0 5	3	INFLUM TO LAME COMO DAM	
21	1 =	113 124 132 142	
10.0	x -1.565 x 1 - 001FLU	OUTFLOW FHOM LANE COMU DAM	
≻ 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1	4	15.6 16.5 17.6 18.1 14.6 19.0	50.5 51.6
20 21 20 20 20 20 20 20 20 20 20 20 20 20 20		160 184 726 1643	
25 25 20 20 20 20 20 20 20 20 20 20 20 20 20	1000	17.6 22.6	
		PHEY I'S UP SFINDENCE OF STHEAM NETWORK CALCULATIONS	
		HUNDE HYDROGRAPH AT INFLOW	
1			
			7 40

NaTIUNAL OAM INSPECTION LANE COMU DAM		и <i>Р</i> яовнам 515	METHC IPLT IPHT NSTAN 0 0 -3 0 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	E РЕКРОИМЕ!) HT10= 1 .15 .25 .50 1.00	UTATION	UPLT UPHT INAME ISTAINE IAUTO	C HATIU ISNUW ISAME LOCAL	142.00 0.00 0.00	STHT 1.0	C= 0.00 HIUH= 2.00 C= 0.00 HUUH5, LAG= 4.50 VOL= 1.00 H3. 107. 130. 160. 191. 444. 494. 535. 577. 609.
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	FLUOD HYDHUINAPH PACAGE (HEC-1) DAM SAFETY VEWSION JULY 1474 LAST MODIFICATION 20 FER /4	NATIONAL DAM INSPECTTO LAKE COMO DAM HYDHULUGIC ANALY	NAIN 10AY	HULT .03		100	TANEA SMAP THSIJA 6.00 0.00	.us 113.uo	υιτκη μπιοι Ερδιν υ.00 1.00 0.00 υ.011 H)	STHTUE -1.

C

																																	1					1	7 48		
									1	162.	154.	1 60	135.	1.40	- 62	114.	114.	117.	1117.		121.	123.	129.	131.	136.	162.	. 60	153.	15%	104.	169.	175.	180.	191	197.	206.	221.	- 1152			645.
	272.	153.	94	25.	16.	ກ ົນ	,	;	ross	10.	10.		0.		70	.01	.01	3 0	10.	ō.	10.	3.0	10.	10.	3	10.	6	.01	0	10.	0.0	.01	0 0		.01	2.5		10.	5.5	13.	.03
	288.	163.	• 06	27.	15.	r i		,	¥		10.		0.	10.			0.	3 6	0.	٠ و و		10.	10.	10.	.01	[] [10	10.	10	.01	10.0	• 05	ง เ	50.	20.	ر د و	, co.	C.		. 6	÷0.
	07.			 	16.	. .		,	. ⊿	.02	50°	20.	- 05	ر. ده.	0.0	() ()	-05	ر د د د د	• 0 5	20.	ر ٥	~ 0 ·	.00	20.	20.	٠. د د د	20.	.0.	20.	-05	20.	• 06	90.	.04	• 04		. 0	٠.	, o.	\$0.	• 06
10 10 10 10 10 10 10 10	m.	-			i				PERIOD	151	152	15.4	155	156		3.5	160	161	163	104	166	791	154	170	172	£7.	1.3	176	178	179	2 1	182	e e	13.	185	187	7 2 2	65	141	F 6 !	151
	52	200	00.	31.	17.	* ¢	'n	ċ	Ž	1.10	1.20	7.4.	1.50	2.00	07.7	2.30	6.40		3.10	3.70	3.40	4.00	01.4	4.20	04.4	4 1 0 0	2.10	05.d	7.30 7.40	5.50	5.00 0.10	0.50	6.30	6.50	00-7	7.20	7.30	7.40	7.50 2.00	3.10	N.20
13	344.		501	33.	8.	• • • •		÷	10. 10.0	1.02	1.02	1.00	1.02	1.02	70.1	1.02	1.02	7°07	1.02	1.02	- 1.02	50.1	1.02	1.02	1.02	1.02	1.02	1.02	1.00	1.02	1.02	1.02	20-1	1.02	1.02	20.1	1.02	70.1	1.02	1.02	1.02
14. 14. 14. 12. 14.	375.	201	113.	35.	19.	.0.	3.	:	NI)-UF-PER1011	10.	• :	r E	7.	7.	ċ d	S.	۶.	¢ 7.	•	* d	3.	w w • v	3.	e c		*		~ ~	1.	.	•	•	• 1	: -:	1	• •		• • • • • • • • • • • • • • • • • • • •		-	•0
13. 13. 13. 13. 13. 13. 13. 13. 13. 13.	5 3	<u>.</u> :	₹;	99	50.	: `	3	-	0.55				000	5.	000	9	00.	200	00.	000	60.	60.	00.	000	69	000	00.	000	00.	00.	200	00.	000	00.	00.	0 0	00.	5	000	00.	00.
12.0 13.0 14.0	32.		· .	. H.		12.	•	:	` ¥	. •		• •	•	•	•		•	• •	0.00	000	00.0	200	0.00	0.00	0.00			•		•		•			•	• •		•		•	00.0
14.									4	000	000	33	00.	99.	000	0	00.	70	00	90	3	000	00.	000	90.	9 9	00.	3.0	203	00.	000	00.	99	00.	0.	0 5	00.	3	000	00.	00.
	444		1 1 1	. .	£2	£ 7	9	-	PER[191]	-	~	- 3	ŝ	د ا	~ 1	7	0.1	= 2	13	<u>* </u>	12	17	2	₹ ₹	137	€ ₹	. c.s	\$ 6	2	ર્ :	? - -	32	2	ŧ	36	÷ 5	.	0	7 }	F #	*
	***	.000	9 6		۲4.		,	Ň	N. XI	01.	07.	3	Ç.	5	0 7	1.30	1.00		-01.2 	2.7	2.40	4.00	1.1.5	3-30	3.60	4.50	01.	07.4	04.4	4.50	5.10	5.20	5.40		• '	07.0					1.60
									MU.UM				10.1		30.1	1 0 0	1001	1.01	10.1	3 3	13:1	70.7	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	3	1001	100	10.1	10.1	70.7	1.01	13.7	10.1	10.1	1.01

										•								•		•				-							1	•		<u>'</u>	\mathbf{C}		О О						Î		1		ı	ı 1
																																															S.	1
	323.	345	• 60+	396.		477.	-000	536.	566.	597.	628.	, 224.	366.	144	777	#05.	H33.	100°	013	? 🕶	072.	1004.	1047.	1163	1201.	1267.	1343.	1527.	1640.	1768.	2/01	2261.	2400.	2676.	3166.	3463.	3779.	4505.	*405*	5317.	5/51.	6,460	71.00.	7636.	8155	•00%	4745.	0600
	70.	.01	10	10.	7 6			.0	.01	.01	• 01	• 01		3 3		.0.	.01		5	10	.01	9.	٠. د	3 3	10.	.01	3:	70	10.	10:		1 7	.01	. 01	7 0	10.	5	5 0	.61	10	70.	7 6	10.	70.	7 0		.01	١
!		50.	ر د ا		٠ د د		20.	. 05	. 05	• 05	50.	• 05	20.	ر د د		. 65	-05	50.	2 4		35	.35	٠ د د			£4.	£.	4 4 0 (1)	. 53	£5.	5.5		•53	6.4		3.70	٠	 	•50	000	00.	0.0	34	66.	7		2.	
	• 0.6	• 0 •	•05	• 0 •		9	90	, c	• 0 •	90.	• 04	90.	• 0.	. 4	5 6	90.	÷0.	90.	60.	. 4	3,4	.34	٠3,	٥٢. د ۲	, 4		. 64.	3 4 7 F	.54	• 5.			•54	64:	5 4 4 5 5 4 4 5 6 4 6 4 6 6 6 6 6 6 6 6	3.71	1.07	5.5	.51	اد.		<u>,</u> ,		64.	* 4			
	961	161	86	66.)))	707	707	204	205	505	201	204	502	010	717	213	517	215	217	218	513	220	221	777	554	255	526	22.	622	230	257	233 233	234	232 233	23.7	, 4£.5	233 273	172	245	543	* ;	, ç	742	2 4 8) { (251	255	7 7 6
	3 1	ψ,	•	∹ '	0 0	, 4		0	Ξ.	٧.	06.01	0.40	0.00	00.1	02.1	11.30	11.40	11.50	00.21	2.20	12.30	4	ů,	00.51	• ~	13.30	4			4.20	•		•	~ (5.30	4	5.50	: -:	~	16.30	0.4.0	00.7	-	~	7 . 50	7.50	•	
	1.02	1.02	70-1	20.1	1.02	20.1	1.02	1.02	1.02	1.02	1.02	1.02	20.1	20.1	20.1	1.02	1.02	20.0	1.00	1.02	1.02	1.02	20.1	70.1	20.1	1.02	1.02	2001	1.02	1.02	1.06	1.02	1.02	1.02	20.1	1.02	50.1	1.02	1.02	1.02	1.02	700	1.02	1.02	1.02	1.02	1.02	-
	.	• •		• •	• 6		• 6	• 0	0	•0	• 0	•	•		• •		•0	•		• •	• •	•0	• •		• •	0	0	• •	· o	• •	•	• •	• 0	• •	• •		•	0	• 0	0	.	, n	16.	24.	4.4.	55.	•60	
	00.	00.	00.	00.	000			00.	00.	00.	00.	00.	00.		•	00	00.	000	000	000	00	00.	20.	00.1	5 E	50.	F.0.	7 M	.03	£0°	1	.03	.0.	3 .	4 4	40.	40	140	• 0 6	500	7 : 0 :	2 2	10.	10.	2 5		.01	1
i	•	•	•	:	000	•	9	9	٠.	٦.	•	00.0	000	000		00.0	0.00	0.0		0000	0.00	0.00	0.00	00.0	00.0	0.00	00.0	000	0.00)) 0	20.0	00.0	00.0	0.0	00.0	0.00	00.0	20.0	00.0	£0.	/2.	• •	.03	€0°	36	.03	• 0 3	2
	00.	00	9	200	٠ •	9	000	00.	00.	00.	9	00.))		000	00	00.	00.	3 9	00.	00.	60.	00.	00.		. u	. u.	50	.03	£0.				4 :	* *	.04	* 0 • 1	1 90	90.	=	₹		90.	***)) 	3	*0.	
	£ ;		3 - 	3 :	ر د ع	3	7	, t	ا	, C	57	Ų	6 :	5	? ?	53	40	ۍ د ۱	6,7	- 40 0 - 0	2	0/	6	\ \ \ \	2	۲,	2	- K	12	G	 	y m	1,	T :	o ~ T I	Er	Ŷ :	5	75	8	3	ζ÷	15	¥ ;	100	101	701	1 = 1
	7.40	7.50	00.5	07.4	0 7	0 4	0 0	000	4.10	9.20	9.30	04.4	٠٠٠ ١	000	07.01	10.30	10.40	10.50	00.11	11.50	11.30	11.40	11.50	16.00	12.20	14.30	12.40	14.00	13.10	13.20	13.39	13.50	1.00	14.10	14.30	14.40	14.50 00.41	15.10	15.20	15.30	17.40	16.00	10.13	10.00	16.40	16.50	17.00	17.10
	1.01	7	10.7	10.1	10.			10.1	10.1	10.1	1.01	1.01	10-1		7 - 7	10.1	10.1	10.1		10-1	1001	1.01	10.4	10.1	70.1	1001	10.1	100	1.01	1.01	100	10.1	10.1	100	1001	1001	10.1	13	1.01	10.1	10.	10.1	10.1	10.4	10.1	101	10.1	 -
		_		,	<u> </u>		,			○			_					~		(^					<i></i>				,	<u>.</u>		ე ე		O		,	, ,		C		_		

1001	17.40	106	Eu.	70.	10:	145.	-	1	452	•03	20.	3	11553.	
10.1	10.00	0 0	50	ر د د د	- ~ ·	. 66.		20.20		. C	> 0 · 0	0.7	12025	
1.01	18.10	201	00.	3.0	00.)•1			E 0 •	-05		12634.	
10.1	18.20	011	00.	•	00.	-255	J .			• 03	₹0.	10.	12455.	
	100.50		300	00.0	00.	- Cau	-		:	60.	- 20-	100	130.30.	
	0 1	27	0 0	000	2 2	336				60.0	V 0	= 3	13135	
10.1	14.00	114	00.	2000	00	354	::		202	6.0	20.	60	13249	
10.1	14.10	115	00.	00.0	00.	346.	:			.03	-02	3	13222	
1.01	19.20	116	00.	00.0	00.	403.)•1			-	₹0.	₹0.	13161.	
43.4	14.40		000	00.0	000	*55.	1:0			•03	20.	73.	13054.	
1.01	14.40	114	00.	0.00	00.	• 640	~			\Rightarrow	. u 2		12890.	
7 ·	06.61	5 2 2	٥ •	00.0	99	453.				60.	∾ :	?	12678.	
7.0	100000	100	00.	2000	200	• 00,	1		1	>		100	25.5	
70 - 7	01.00	121	•	000	- 6	9	•			> :	v (3	10120	
10.	20.00	122	•			• c	•			> :	•	5 6	0041	
	20.40	12	3	00.0		764			i :	, c	7	-	96	
7 7 7	20,00	571	00	00.0		,					7		- C HO -	
70 - 7	00000	25.	90	00.0		9	• •			: :			10455	
10.1	21.10	121	3	00.0	000	ž	1	i	1	·c	100		10056	
10.1	2 - 1 - 20	70		0.00		470.	-			, c	200		2 7 7 90	
0	Z1.30	621		0000		6779				o د	V (0)		4220	
1.01	21.40	130	00	00.0	00	462.			١	E0.	700	- 10	1788	
10.1	21.50	1.51	00.	0.00	00	451.	7•1			C	000	10.	2.52	
10.1	22.00	132	00.	00.0	00	4 34.	`. !			.03	20.	.0.	1444	:
10.1	24.19	1.33	00.	00.0	00.	425.				C	-0.	.01	.1057	
10.1	22.20	1 34	00.	00.0	00.	411.	7.7			.03	-05	0.	1155.	
1.01	22.30	1.45	00.	?	00.	394.				Э	- 02	10.	5747.	
٠ ا ا	24.50	136	35°	20.0	00.	376.				• 03	÷05	.01	545U.	
70.7	24.20	131	2 :	00.0	o :	357.				- 0		5.0	. 1114	
						200		•	•	•	00.0	10.	2/4/6	
7 G	21.77	7 7 7	•		5 6	• • • • • • • • • • • • • • • • • • • •	•			•				
3	73.30) -) •		20.0		• ## • ## • • • • • • • • • • • • • • •	•				•		. H. O.	
	23.40			0.00		272.				•	0.00	00.0	46.78	
	23.50) (* -		0000	2	757				•	•		4411.	
1.02	00.0	77	000		00.	243					•	0000	4181	
1.02	01.	145		3	.01	229.) • (00.0	3044.	
1.02	• 20	144	- 02	.01	.01	215.	~	7	298	9	•	•	3754.	
1.02	.3n	147	÷ 02	.01	10.	203.	-	_	162	0		•	3563.	
1.02	0.4	1.4	>0.	10.	0.0	1.15	-	7.4	244	0	•		33H10	
1.04	0	7 # ~	50·	10.	• 0 1	1 a 0 •	7.1	~	かかど	٥.	00.0	•	3210.	
70.1	00.1	150	20.	.01	٠ ټو	171.	-	0 • 2	300	c.	?	0000	3947.	
									S S	27.24	24.87	05.2	601093	
					} '	1		2	:	•	0			
			7.30	13240		Š	-		9 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	1 \ 5 \				
-				375				51.	17.0	0 3 .	ì			
			INCHES	• !			91	22.42	22	~.				
			Ŧ	!	£.	• · · ·		2.5	574	579.57				
		•	•		ۍ ا	5454. HU3		8271.	28	2/1·				
		1	-			2	,		Ç					

HTUHUGHAPH AT STAINFLUM FOH PLAN 1. HTTO 1

£
5
-
_
-
-
•
-
Z
P.LAN
ũ
₹
+
F CH
<u> </u>
3
u.
3
3
ū
7
=
_
=
5
. 1
_
⋖
I
2
<
œ
رق
5
₹
=
Ξ
=
1

PEAK 6-HUCK 24-HUUF 72-FUUR TOTAL	2 TOTAL TOTAL TOTAL TOTAL TOTAL	AN 1 . HTIO 72-HOUN 72-HOUN	FLOW FOR PU 24-HOUR 19-6 19-6 19-6 19-6 24-19-6 24		нүнновчар нүнновчар нүнновчар не ак 530. 15. 10. 15. 19. 19.	
HYDMOGNARH AT STAINFLOW FOR PLAN 1: HTTO 2 HYDMOGNARH AT STAINFLOW FOR PLAN 1: HTTO 2 HYDMOGNARH AT STAINFLOW FOR PLAN 1: HTTO 2 HYDMOGNARH AT STAINFLOW FOR PLAN 1: HTTO 3 HYDMOGNARH AT STAINFLOW FOR PLAN 1: HTTO 3 HYDMOGNARH AT STAINFLOW FOR PLAN 1: HTTO 4 HYDMOGNARH AT STAINFLOW FOR PLAN 1: HTTO 5 HYDMOGNARH AT STAINFLO	2.28	. 6 2. 28	2.22	31.	37.	CAS INCHES
1000, 1000, 100, 100, 100, 100, 100, 1	2.28	2.28	2.22	14.1	•	1 NCHES
HYDMOGNARH AT STAINFLO. FOR PLAN 1: HTIO 2 HYDMOGNARH AT STAINFLO. FOR PLAN 1: HTIO 2 HYDMOGNARH AT STAINFLO. FOR PLAN 1: HTIO 2 HYDMOGNARH AT STAINFLO. FOR PLAN 1: HTIO 3 HYDMOGNARH AT STAINFLO. FOR PLAN 1: HTIO 3 HYDMOGNARH AT STAINFLO. FOR PLAN 1: HTIO 3 HYDMOGNARH AT STAINFLO. FOR PLAN 1: HTIO 4 HYDMOGNARH AT STAINFLO. FOR PLAN 1: HTIO 5 HYDMOGNARH AT STAINFLO	1700.	•	- 17	31.	37.	SMD
HYDMGGRAPH AI STAINELOW FOR PLAN 1, HTIU 3 HYDMGGRAPH AI STAINELOW FOW PLAN 1, HTIU 2 HYDMGGRAPH AI STAINELOW FOW PLAN 1, HTIU 2 HYDMGGRAPH AI STAINELOW FOW PLAN 1, HTIU 3 HYDMGGRAPH AI STAINELOW FOW PLAN 1, HTIU 4 HYDMGGRAPH AI STAINELOW FOW PLAN 1, HTIU 5	> £			6-H0UH 1102.	PEAR 1324.	CF S
HYUMOGMARH AI STAINELOW FOW PLAN I, MTIU 4 HYUMOGMARH AI STAINELOW FOW PLAN I, MTIU 5 HYUMOGMARH AI STAINELO						
10 10 10 10 10 10 10 10		AN 1. HT10		Ā	HYIJHO(3HAP)	:
10.000.		•				
HYDMOGNAPH AT STAINELOW FOR PLAN 1. HTIO 2 HYDMOGNAPH AT STAINELOW FOR PLAN 1. HTIO 2 HYDMOGNAPH AT STAINELOW FOR PLAN 1. HTIO 2 HYDMOGNAPH AT STAINELOW FOR PLAN 1. HTIO 3 HYDMOGNAPH AT STAINELOW FOR PLAN 1. HTIO 3 HYDMOGNAPH AT STAINELOW FOR PLAN 1. HTIO 3 HYDMOGNAPH AT STAINELOW FOW PLAN 1. HTIO 4 HYDWOGNAPH AT STAINELO	510.	510.	445.	337.		THOUS CU 4
HYLHOGHAPH AT STAINELOW FOR PLAN 1, HTIO 2 PEAN 6-1004 11.59 1	414.	414.	405	273.		AC-FT
HYDMOGMAPH AT STAINELOW FOR PLAN 1, HTIO 2 HYDMOGMAPH AT STAINELOW FOR PLAN 1, HTIO 2 HYDMOGMAPH AT STAINELOW FOR PLAN 1, HTIO 2 HYDMOGMAPH AT STAINELOW FOR PLAN 1, HTIO 3 HYDMOGMAPH AT STAINELOW FOR PLAN 1, HTIO 4 HYDMOGMAPH AT STAINELO	28.94	28.98	24.15	19.14	1	F.
HYTHOGNAPH AI STAINELOW FOR PLAN 1, HTIO 2 PEAN A-HOUN Z4-HOUN TOTAL VULUME 340, 11.59 11	\$ T • T	4	11.1	۷,٠		INCHES SEE
HYDMOGMAPH AT STAINFLOW FUR PLAN 1, HTIU 3 HYDMOGMAPH AT STAINFLOW FUR PLAN 1, HTIU 4 HYDMOGMAPH AT STAINFLOW FOR PLAN 1, HTIU 4 HYDMOGMAPH AT STAINFLO	•::(0	• • •	• -	100	• • • •	
HYINGGRAPH AT STAINELOW FOR PLAN 1, HTIU 3 HYINGGRAPH AT STAINELOW FOR PLAN 1, HTIU 3 HYUNGGRAPH AT STAINELOW FOR PLAN 1, HTIU 4 HYUNGGRAPH AT STAINELO	200) (*))			5.	, , , , , , , , , , , , , , , , , , ,
HYUNGGRAPH AT STAINFLOW FOR PLAN 1. HTTO 2 HYUNGGRAPH AT STAINFLOW FOR PLAN 1. HTTO 3 HYUNGGRAPH AT STAINFLOW FOR PLAN 1. HTTO 4			203	551.	662.	CFS
HYTHROGRAPH AT STAINELOW FOR PLAN 1, HTIO 3 HYTHROGRAPH AT STAINELOW FOR PLAN 1, HTIO 4 HYTHROGRAPH AT STAINELOW FOR PLAN 1, HTIO 4			24-HOUR	4-H00K	P. AR	i
HYDMOGNAPH AT STAINELO. FOR PLAN 1. HTIU 3 HYDMOGNAPH AT STAINELO. FOR PLAN 1. HTIU 4 15. 12. 22.52 23.18 HYDMOGNAPH AT STAINELO. FOR PLAN 1. HTIU 4 HYDMOGNAPH AT STAINELO. FOR PLAN 1. HTIU 4 HYDMOGNAPH AT STAINELO. FOR PLAN 1. HTIU 4					1 1 1 1	
7. 605. 620. 41. 40. 120009. 120009. 120009. 130. 140. 11.26 11.26 11.59 11.59 11.59 165. 135. 194. 204. 204. 204. 204. 204. 204. 204. 20	•	2114 11 11			14.000	
7.00. 12000. 10. 10. 10. 10. 12000. 12000. 12000. 10. 10. 10. 10. 10. 10. 10. 10. 10.		AN 1. HTEU	FLOW FUR PI	AT	HYDHOGRAP	
# # # # # # # # # # # # # # # # # # #						
# # # # # # # # # # # # # # # # # # #						
# # # # # # # # # # # # # # # # # # #	• 611.4	• 00.	340.	•0/2		F 03 500::1
# # # # # # # # # # # # # # # # # # #	- 100	704	306.			2 10 10 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
# # # # # # # # # # # # # # # # # # #		331.	321.	214.		AC-F.
HYDMOGNAPH AT STAINFLOW FOR PLAN 1. HTTO 3 HYDMOGNAPH AT STAINFLOW FOR PLAN 1. HTTO 2 HYDMOGNAPH AT STAINFLOW FOR PLAN 1. HTTO 2 HYDMOGNAPH AT STAINFLOW FOR PLAN 1. HTTO 3 HYDMOGNAPH AT STAINFLO		23.18	55.55	S.	1	3
HYUNGGWAPH AT STAINFLOW FOR PLAN 1, HTTO 3 HYUNGGWAPH AT STAINFLOW FOR PLAN 1, HTTO 2 HYUNGGWAPH AT STAINFLOW FOR PLAN 1, HTTO 3 HYUNGGWAPH FOR PLAN 1, HTTO 3 HY	16.		or i			5.4505-1
HYUNDGWAPH AT STAINFLOW FOR PLAN 1. HTTO 3 PLAN 6-HOUN 24-HOUN 72-HOUN 24-HO. 24014.	•040	• :	r.	• > 7		(E)
7.65. 620. 81. 40. 12009. 60. 12		*	• 301		• 000	
HYDHOGUADH AT STAINFLOW FOR PLAN 1. HTIO 3			24-14/104	A-HOUR	P.E. A.	3,70
7.66. 11.59			!			t
40. 12009. 6. 4. 40. 12009. 6. 6. 40. 1. 200. 12009. 6. 4. 40. 1. 6. 6. 11. 6. 6. 11. 6. 6. 11. 6. 6. 11. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6.			FLOM FOR PI	H AT STAIN	HYDHOGNAPH	i
40. 12009. 6. 6. 1. 6. 12009. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6.						
7.66. 12009. 12009. 12009. 12009. 12009. 12009. 13. 11.26 11.59 1	•)))	1) } }		
7.66. 11.59	300	306.	297	202		14005
7. 66. 11.26 11.59	244.	240.	241.	164.		31-11
### ### ### ### ### ### ### ### ### ##	17.39	17.39	16.89	11.49		1 t
7. 66. 7. 66. 11.59 10. 64. 11.59 10. 64. 11.59 10. 11.56 10. 11.59 10. 16. 16. 16. 16. 16. 16. 16. 16. 16. 16	. 66	99.	99.	54.		LICHES
7.66 11.26 11.59 11.59 11.59 11.59 165. 135. 193. 204. 204. 204. 204. 204. 204. 204. 204	510.	۶.	ů,	;	11.	CMD
7.66. 11.26 11.59 10.9. 161. 165. 165. 165. 165. 165. 165. 165		• • • • • • • • • • • • • • • • • • • •	1000	1.00		
40. 1. 40			74-400K	4-400K	# 6 H	490
7.66 10.9. 10.				,	2	
2005- 2200- 11. 400- 11. 100-	J				100	
2605. 220. 41. 40. 11. 40. 11. 40. 11. 46. 46. 11. 26. 11. 59. 11. 165. 11. 165. 135. 194. 204.	^	AN 1. MT10			GA WOONGY IN	
2605. 60. 11. 40. 11. 40. 11. 40. 11. 40. 11. 40. 11. 40. 11. 59. 11. 105.						
26. 1. 40		! ! !				
2605 40. 1 6. 2. 1. 26. 1. 26. 11.59 109. 101. 165. 1859	•		•			
200. 11. 40. 1.	204	204.	199.	135.		T 00 S001
26. 1. 40. 1. 40. 1. 40. 1. 40. 1. 40. 1. 40. 1. 40. 1. 40. 1. 40. 40. 40. 40. 40. 40. 40. 40. 40. 40	165.	165.	161	100		AC-+ [
7. 6. 2. 1. 1. 1. 40. 1. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4. 4.	71.54	60.11	02.11			
7 60 60 60 60 60 60 60 60 60 60 60 60 60	25.11	26.	11.26	7.56		7
7. 6. 2. 1.	94.	94.	* * *	9.30		INCHES
250. Al. 40.	340.	•	•	•	:	SEO
250. H	044		:			145
			. T a	• n > >	.002	? ₹

,

				i	;			
	S J O	Pf A4	6-400K	24-HCCH 604	12-HOUM 303.	TOTAL VOLUME		
Ċ	LMS INCHES	56.	2.20	3.32	3.42	3.42		
	+ UJ SUO-1		1011.	1205.	1530	1241.		
		ндиновин	₫	T.STAINFLUA EUM PLAN 14 HTTO	LAN 11 HT	. 0		?
^		PE 4x	5-HOUR	74-HOUR	400H-21	TOTAL VOLUME		
	C45 INC 45 5	. 45	3.77	24.5	14.	4251. 5.70		
	AC-FI T-OUS CU M		95.72 1366. 1685.	140.74 2008. 2477.	2551.	144.89 2064. 2551.		
AZU MI Q		HYDHOGRAPH	6	STAINFLOW FOR PLAN 1. HITO	LAN 1. HT	× 0		
કેદમ્યાનન		7. A 2.	5-100x	24-FUUH 2024-	1001	TOTAL VOLUME		
	542	187	156	./5	28.			
- a	I SCHES MM		191.44	11.08	11.41	11.41		^
au i sa	14-7£ F UJ SUU-1		27.32.	4017.	4135	4135. 5101.		
Paymen								
3H^Ov		нүркобидри	A T	STAINFLOW FUM PLAN 1. MITU 9	LAN 1. MT	6 0		
, ^	S a J	PF AF 13640.	6-HOUK	24-HOUR 4050.	72-4004	TUTAL VULUME 600472.		
•	C4S IRCHES	375.	312.	115.	57. 22.82	17003.		С
	AC-11	:	5454.	562.94 HU34. 9909.	579.57 8271. 10202.	574.57 8271. 10202.		
C	•••••	•	•	•		•	•	(:
			HYDROG	HYDROGRAPH TROUTING	1 9N			
		טטודו		OH FHOM LAKE COMU DAM	DAM			
	DOLLIO	LO ICOMP	i i	I TAPE 0	JPL I	UPHT INAME 0	1574GE 1AUTO 0 0	Sh. //
ට ට	0F055 CL.U55	55 AVG		HOUTH DATA	دب	0 dwd1	LST# 0	7
-	i			:	:			

STAUE				0 1	9	0.000 0.000	00000	-151			
0. 104. 45. 77. 124.	Ì	14.00	15.10	LO ;	16.60	17.60	18.10	18.60	19.6		21.60
0. 134. 312. 794. 0. 134. 312. 794. CHEL SP-10 COUN EXP ELEVI COUL CAPE REPUBLICATION OF O. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.	}	0.00	00.00	00.66	160.00	184.00	726.00	1663.00	424A.0		11504.00
CHEL SP-119. 23. CHEL SP-110 COUNT EXPA ELEVI COOL CAMEA EXPL CHEL SP-110 COUNT EXPA ELEVI COOL CAMEA EXPL LITED COUNTELON TOWN IN MATIO 1 EIGHT COUNTELON TOWN	SINFACE AMEA=	=	4	71.	124.						
CHEL SPAID CUON EAP, ELEVI COUL CAMÉR EAP, LIAND LOS DANNIOS STATION QUIFLUS PLAN II MATIO I STATION QUIFLUS PLAN II MATIO I OUTPLUS PLAN IN THAT IO I STATION QUIFLUS PLAN II MATIO I OUTPLUS PLAN IN THAT IO I OUTPLUS PLAN IN THAT IO I OUTPLUS PLAN II MATIO I OUTPLUS PLAN IN THAT IO	CAPACITY=	9	134.	312.	7.44.			!			
CHEL SP-10 COUN EAP4 ELEV COOL CANEA ERPL 110-PL COUNTELO PLAN I HATTO 1 END-OF-PEHIOD WOUGHAPH OALINATES 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FLEVATION=	9	15.	4	23.				:		
10Ptc COOM DAM 10 DAM 1			İ	į		ELEVL 0.0		w			
17.0						DAM DATA					
6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		!				0.0 0.0					
CHO-UF-PEMIOU HYUNDGRAPH ONLINATES O					STATIUN OL	ITFLU. PLAN 1					
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0					END-OF-PEWI	ОО НҮОКОСКАР	H OHLINATES				
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0						İ		•			
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		• • •					• •	• •		• • • •	
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0		• •				ļ		• 0	0.0	0	
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0		0.0	ļ			• •	• •	• •		• •	
7		: د		:	0) 	•	• •		• 0	
A		• •)	• •	• •	• •	• •	
10. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0		٠.		į			•	• 0	3	0	
2. 3. 3. 3. 3. 3. 4. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6.		• •	. 0			00	• •	• •	• •	• •	
4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4		•	(] 	 	•1		• • •	~	-2	
4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4		• •	n 4			• • • • • • • • • • • • • • • • • • •	• • • •	n 4	;;	• •	
4		٠.	ر . ا		\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	:	5.	'n	5	5.	
4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4		n d	4 4		4 4	3 3	• •	• •	;;	• •	
4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4		•	4		3	•	•	•	;	•	
6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6. 6			4 4		4 4	4 4		; ;		• •	
6. 9. 4. 10. 11. 11. 12. 12. 13. 14. 15. 16. 11. 11. 12. 20. 21.<										۶.	
13. 14. 15. 15. 16. 17. 19. 20. 21. 24. 24. 30. 32. 34. 37. 39. 43. 25. 26. 36. 72. 17. 82. 87. 92. 103. 103. 104. 110. 112. 113. 131. 132. 133. 133. 133. 133. 133. 133. 135. 126. 126. 125.			£O		•	- 01	· [÷ [. F.	
24. 24. 37. 34. 37. 34. 43. 43. 43. 43. 43. 43. 43. 43. 43			į				17.		20.	21.	
100. 103. 105. 104. 110. 112. 117. 117. 117. 117. 126. 127. 127. 131. 132. 132. 133. 133. 133. 133. 133						-	34.	37.	34.	43.	
122. 124. 125. 127. 124. 129. 130. 131. 132. 132. 133. 133. 133. 133. 133				1			112.	115.	117.	114.	
. 131. 131. 130. 129. 129. 126. 127. 126. 125.					•		. 551	130.	131.	132.	
			İ				126.	127.	126.	125.	~

138	138.	134.	134.	ŧ	134.	138.	134.	13н.	138.	138.	
	138°	13A.	. A	134°	1 JR.	138.	138.	138.	138.	134.	
137 138	138.	134.	34.	138.	138	138.	3.8	138	134	134.	
13. 13.	138.	134.	1,50	138.	138.	138.	13%	138.	138		
134 134	130	134.	134.	134.	138.	138.	138	134.	13%	138	
134. 134.	138.	134.	13A.	136.	13₽.	138.	138.	138.	138.	136.	
134 134	136.	13A.	13A.	138.	138.	136.	138.	138.	13%	138.	
	137	1.4.	1 24.	13.	- K.	134.	34.	138.	138	- 557	
19.0 19.0		• • • • • • • • • • • • • • • • • • • •	. a	• 00 T		. 1	ייר		100		
13. 14.0 1	133.	134.	13.0	139.	139.	134.	വ സ	134.	13%	139.	
140 141	134.	133.	140	140.	140	140.	• •	140	140.	140.	
	140.	140.	140.	140.	140.	140.	141.	141.	141.	141.	
	141.	141.	141.	141.	141.	141.	141.	141.	141.	141.	
140. 140.	141.	141.	141.	141.	141.	141.	140.	140.	140-	140.	
100 100	140.	140.	.041	140.	140.	140.	140.	140.	140.	140.	
14.0 14.1	-071					0.00	- 0 - 1	0 4	0,1		
1	0.91	- 0 - 1		• • • • •	. 0 % [• 0 9 7	• 0 • 1	• 0 • 1	0 0 4 7	• • • • • • • • • • • • • • • • • • • •	
15. 15.	• 0 • 7	140			140	•	• • • • • • • • • • • • • • • • • • • •	• • • • •	• • • • • •	140	
433	• 1	142	16.2	2,7	142	147	- 24		16.4	161.	
150		163.	143.	143.	144	144.	9 4 5 1	144.	165.	145	
154. 153. 154. 157. 158. 160. 162. 167.	145	145.	146.	147.	147.	148	143	149	150	150	
140. 160. 173. 170. 176.	151	152	153.	154.	156.	157.	· ru	160.	162.	163.	
1842, 1911, 193, 1945, 2190, 2000, 2000, 2000, 2010, 2190,	165.	157.	169.	171.	173.	176.	_	180.	182.	185.	
217. 219. 219. 219. 219. 219. 219. 219. 219	1.87.	180.	161	193.	195.	19н.	9	505	504.	206.	
STARE 4.0	207.	• 652 652	<10. 210.	212°	213.	214.		216.	217.	21A.	
2 TAGE 1	7 TA		214	214.	216.		⊸ -	619.	213.	212.	
STARRE ST						• • • • • • • • • • • • • • • • • • • •	•	• • • • • • • • • • • • • • • • • • • •			
					STA						
	0.41	0.0	0.41	•	* *	0.4	•	•	0	0	
	9 4	. 4	0.4		9 4	. 4	•	•	9 4 7	0.4	
	9-9-	14.0	9		14.6	6.9			14.6	9.4	
	14.6	14.0	14.6	٠.	14.0	14.4	•		14.6	14.6	
14.0	14.6	14.6	14.5	•	14.6	14.6	•	•	14.5	14.6	
	14.6	14.0	0.41	• (14.6	14.6	•	•	14.6	14.6	
	C .	•	0	•	0.4.	9.4	•	•	•	0.	
	0 4	0 5	4 4		C - 4	0.4	•		0 4	0.4	
	9.41	14.5	14.6	• •	14.6	9.4			14.6	9.4	
	14.6	14.6	•	14.6	14.6	14.6	•	•	14.6	14.6	
	14.6	14.6		14.6	14.6	9.4	•	•		14.6	
	0 * ; -	0	•		•	7.91	•	•	\ • ·		
					14.7	14.7					
		4		16.3	4	14.6				4.6	-
	14.6	14.5	•	14.6	14.6	14.6			14.6	14.0	
	14.5	14.6	•	4.4	14.0	14.6	•	•	14.6	14.6	
	14.5	0.4	•	14.6	14.6	14.6	•	•	14.7	16.7	
	1.4.	7.9.	•	7 * 4 !	•	16.7	•	•	14.7	14.7	
			•	, ,	•	14.1	•	•	1.01	7.4	
	3 4	4 4	•	/ • • · · · · · · · · · · · · · · · · ·	•	7. 4.	•	•	\	· ·	
15.5 15.5 15.4 15.4 15.5 15.5 15.5 15.4 15.4				7 4		15.0			15.1	15.1	Ġ.
- 0'4' 5'5' X'5' X'5' L'4' L'5'	7:51	15.6		15.3		15.4			15.5	15.5	5
the test total part total test part	5,2	1 1		•							

																										-						Ü	Jun-	
16.1								0.	• •	0.0	• •		:	•0	• •	3.	• 9	: :	3.	i s	۶.	• •	12.	1 H .	12.	121.	15%	164.	166.	13%	1 44.	***	1 34.6	
16.2								0	• • • •	.0	.		•	•	• •	3.	٠,	: :	•	• i	\$	ò	12.	17.	99	~	154.	3.0	167.	134.		138	13%	
16.2	•	VULUME 6635. 188.	6.40	113.				• 0	• • • •	• 0	• •	• •	• 0	• = 0	• -	œ.	ķ.	: :	ċ	ب • د	, ¢	o a	11.	• • •	61.	113.	150	169	167.	1 3H.	• × ·		1 3 M •	. 1
16.2		TOTAL		i ! :	4AT10 2	JHD INATES		•0	• •	•0	•	• •	• 6	• 0	• •	٠.	្ចំ r	: .:	ċ	ê vî	, w	o d	11.	16.	, 26.	104.	167	169	167.	1 3M.		1 3 H •	. #C.	
16.2	1	72-HUUR 22.	6.40		PLAN 1. F	UHOGRAPH (0		0	•		•	• a	• •	, n	.	• ~	•	ċċ		• *	11.	15.	. 51.	106.	1040	169.	168.	138.	34.	136.	138.	
16.2		24-HOUR 45.	6.25 89.	110.	STATION OUTFLO. PLAN 1. HATTO	E.IO-UF-PERIOU HYUHOGRAPH UHDINATES	OUTFLOW	••	• •	• 0	•	0	0.	• • • •	• •	2.	•	• •	7.	• •		•••	10.	15.	46.	102.	. 99	169.	168.	STUMAGE	1 1 1 1 1 1 1	38.	13%	
16.2	S	6-HOUH 127.	4.40	11.	STATIO	E:10-0F-		0.0	• • •	0.	• 0		• 0	• 6	• •	2	•	• • •	7.	• •	5.	.0.	10.		42.	•нъ.	153.	164.	164.	134.	1 48.	13A.	HC I	
10.2	47.50 HOURS	PEAK 133.	!					0.	• c	.0	• c		•	0	• •		• ·	• •	,,			٠,٠	10.	14.	34	. [5	153.	168.	168.	134.	134	. H.		
16.2	. AT IIME	CFS CAS	INCHES MA 14-14	Trous cu M				0.0	• • •	6.	.		• 0	• 6	• •	1.	•	• • •	7.		5.		7	13.	36.	4 E		148.	144.	46.	1.44	· ·	7.	. 36
10.1	££1 51							0	• • 5 5	• •	۰ ق		• •		• d	• 1	•	ċ ~	.'	ò	5.	• 9		en j	.*5	18.	165.	167.	169.	134.	1 23.	139.	- 13%	
	PEAR OUTFLUW																																	

																																7/ 45	X 7:18	
					c	0	• c	0	•••	0	• •	:	;;	•	• •	ž		¥.		24.	• • •	146.	230.	249.		138. 138.	13%.	138.	134.	13A. 138.	138.	13A.	140.	142.
							3 6	2	• •	0	• •	:	;;		* 20		::		: <u>:</u>	2	.26	141	199.	257.		138.	138.	138.	138.	138.	138.	134.	140	142.
6922 253.	8.61 123. 152.	· ·		!	ć	ċ	00		• • •	•0		•	3.	.	* ±		::	•	11.	\$2. •2.	35. 35.	136.	183.	265.		136.	138.	138. 138.	138.	134. 134.	136.	138.	140.	142.
30. 1.	6.61 123. 152.		I. HATIO 3	ENU-OF-PERIOD HYDROGHAPH ORNINATES	c	0	0		• •	0 -	• • • •	1.	* *		• •	ž,		œ.	.0.	21.	78.	131.	168.	271.		138.	138.	138.	138.	134. 134.	138.	138.	140.	147.
50.	8.38 120. 147.		STATION OUTFLU. PLAN I. HATIO	OU_HYDROGRAN	OUTFLOW		• c		• •	0	• •	1		 !	• •	\$	7.	10		20.	72.	126.	181.	275.	1		1			138.		138. 138.	!	_
163.	5.07 41.		STATIUN OU	NU-0F-PERI	1100	0	•		· ·		• •	0	e e	x:	• •	œ.		É	10.	19				278.	\$10	133.				138.				
164.			!			0		0		0			?. 5.			*	•	i 		!		911		217.		4E.1		133	138	134.				
CFS CAS	44 AC-FT AGUS CU 4																	. 30	• =	A				222						134 14 14 14 14 14 14 14 14 14 14 14 14 14			1	
	0641								•••				۱. ۶.				y. /.							265						4. 138. 5. 138.				
					•		- •		- -		- -		•						- 13		j ž	10.	21	251. 240.		35.1	~	ų į	<u> </u>	138.	<u> </u>	134	3	•

A CONTRACTOR OF CANADA CONTRACTOR OF CONTRAC

							•				
	143.	143.	143.	143.	143.	143.	143.	143.	143.	143.	
	143.	143.		143.	1430	143.	143.	142.	143.	142.	
	144.	142.		142.	142.	142.	142.	142.	142.	142.	
	144.	142.		142.	142.	142.	142.	142.	144.	142.	
	163.			143.	144	144.	144	144	144	145	
	1.5.	145.		146.	146.	9	147.	147.	147.	147.	
	63.	9 8 9		169.	6	5 1	.150.	151.	151-	152.	
	153.	153.		125.	9,5	7,7	158.	101		163.	
	141.	105		203.	208.	2	217.	222.	227.	732.	
	237.	242.		252.	5.5	29	267.	272.	277.	281.	
	286.	540		298.	301.	9	308.	311.	313.	315.	
	317	317-	318.	318.	318.	316.	314.	317.	317.	315.	
	•	• • • • • • • • • • • • • • • • • • • •		•	• • • • • • • • • • • • • • • • • • • •	•	• • • •	• 315	• 116	•	
					STAGE	i	•				
	9.4.	9.4	14.6	14.6	14.6	•	14.6	9.4.	9.4.	14.6	
	9-41	0 0	4.0	. 4 . 6	0 4	• •		14.0		0 4	
	14.5	14.6	14.0	14.0	14.6		14.0	14.6		14.6	
	14.6	14.6	14.6	14.6	14.6	•	14.6	14.6	•	14.6	
	14.6	14.6	14.6	74.6	14.6		14.6	14.6	•	14.6	
	14.0	14.6	9.4.	14.6	14.6	•	14.6	14.6	•	14.6	
	9.4	0.4	9.4	9•41	14.6	•	14.6	6.4.	•	9.	
	9	9-4	4	6 4	14.6	• •	9-4	9.91			
	14.6	0.41	14.6	14.0	14.6	•	14.6	14.6		14.6	
	14.6	14.6	14.6	14.6	16.6	•	14.6	14.6	•	14.7	
	14.1	14.7	1	14.7	14.7	•	14.7	14.7	•	14.7	
			\ . • · ·	٠	7.71	•	14.7	14.7	•	\••\ •••	
	1 4 - 7	7.0	14.7			•	14.7	7 - 4	•	7 - 4	
	14.7	/**	14.7	10.4	14.7		14.7	14.7		14.7	
	14.7	14.7	14.7	• 1	14.7	•	14.7	14.7	•	14.7	
	1.4.	7.41	.,	14.7	7.97	•	14.7	14.7	•	1	
	14.7	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	14.7	7 - 7	• •		14.7			
	1	R	14.8	H	14.8	•	8.4	9.41		14.6	
	14.5	14.0	D 1	14.8	14.8	•	14.9	14.0	•	14.9	
	14.0	16.9	14.9	15.0	15.0	•	15.0	15.1	• ,	15.1	
	7.4	15.6	15.6 15.4	15.3	15.3	•	15.4	15.5	•	15.6	
	100	16.5	16.0	16.7	16.8		16.9	17.0		17.2	
	2./1		17.3	17.4	17.4	•	17.5	17.6		17.6	
	11.7	17.1	17.7	17.7	17.7	17.7	17.7	17.7	17.7	11.7	
	1/./	17.6	17.6	17.6	17.6	•	17.6	17.6	•	17.6	
PEAK OUTFLOW	15 278	8. af Time	47.50 HUUMS	Ş							
			PEAK	4-HOUR	24-H0U	72-HOUR	TOTAL	VULUME			
		5		610.		9					
		INCHES SACORTS		· ~ ·	•			367.			Ö
		E	:	200		A0 - 1 - 1		* • • • • • • • • • • • • • • • • • • •	!!!		77.uc
						•		2			

			STAT	ION OUTFL	0. PLAN 1.	HATIO 4	•			
			E~0-0F	JF-PERIOD HYDROGR	HYUROGRAPH	UMDINATES				
				IFL0		; ;				
2 2	• •	• • • •	• • • •	• •	00	• •	• • • •	• •	••	
٥.	0	•	• 0	• 0	• •	•	د م		0	
• •	• •	• c	• •	• •	• •	• •	• •	• •	• •	
0	. 0	c	0		0	• 0	c	0	•	
.	•	e c	0		• •	• ·		• •	• •	
	0	0			0	•	c	0	0	
.	•	ċ	• •	ė.	• -	• •		• •	• •	
			3.0	3.		• •	;		5.	
: هٔ ا	, a	•				Ĭ,	\$.	÷ ;	
,	10.		101			• • • • • • • • • • • • • • • • • • • •	:			
	::	::	• •		::	11.		10.		
10.	10.	10.	10.	10.		10.	10.	10.	•	
;	•	o o	• •	• •		•	.	,	· •	
* ;	• •	• •	, a.	.01		, o	• <u>-</u>	10.	• : :	
11.	11.	-11-	12.	12.	13.	13.	13.	14.	14.	
15.	15.	15.	16.	17.	18.	18.		20.	20.	
21.5	25.	34.	25.	28.6	(*	• • • •		. 68.	30.	
.10	67.	73.	.62	96.	• E6	100.	104.	108.	113.	
110.	123.	129.	134.	140.	146.	152.	159.	162.	164.	
167.	149.	172.	174.	177.	179.	181.	183.	544.	316.	
. (J.	* 7 4			4 1 B.	402	336.	370	353.	337.	
322.	306.	545	277.	264.	250.	238.	226.	214.	203.	
				STURAGE	ja t					
138.	134.	l JA.	138.	134.	i .	134.	136.	138.	134.	
138.	134.	. 44. . 44.	138.	133.	138.	138.	138. 138.	138.	138.	
138.	134.	134	138.	134.	Ī	138.	138.	38	138.	
2 T	134.	13k.	1 3 H .	138.	- -	1.48.	138.	138.	138.	
138.	13н.	134.	134.	138.		138	134.	138.	134.	
138.	138.	134.	. HE .	139.	- -	138.	138.	138.	134.	
136.	134.	134.	134.	138.	7	138.	130	134	13%	
130.	134.	138.	134.	138.	~	139.	134.	139.	139.	
39.	130.	139.	140	140	1	140	141.		141.	
		4 4 4	166.	166.	٠ -	- 641			16.5	
145.	165	145.	145	145.	· -]	145	145.	145	145.	
145	144.	166.	144.	144.	, -	144.	1 * * * 1	144.	- + + -	
* F # # # # # # # # # # # # # # # # # #		164	144.	44		4 4			144.	\ \frac{1}{\sqrt{1}}
143					•	•	•			
	1630	143.	143.	143.	_	143.	143.	143.	143.	

9 C C		147.	147.			.84	.07	144.	147.	150.	
	150	151	151.			153.	5.3	154.			
	156.	157.	158.	154.	161.	162.	. 49	165.	167.	169.	
	1/1.	173.	176.			85.	.88	192.	196.	200-	
C C	205.	210.	215.			32.	38.	544.	251.	257.	
000	264.	270.	277.			97.	304.	310.	316.	321.	
C	325.	327.	339.			33.	333.	333.	333.	332.	
c	131.	331.	330.				366.	324.	323.	322.	-
c	361.	360.	31%					313.	314.	313.	
`					STAGE						
	14.6	14.6	14.6	14.6	··c	1 9 . 4	4.6	14.6	14.5	14.6	
	14.6	16.0	•	. •	14.6	•	9.4	14.6	14.6	14.0	
^	14.0	14.0	•	4.4	14.6	•	9.4	14.6	14.5	14.6	
	14.6	14.5	•	14.6	14.0	4.6	9.41	14.6	14.6	14.6	
,	14.5	14.0	14.5	14.6	14.6	14.6	14.5	14.6	14.5	10.0	
9	14.6	9.0	•	14.6	14.6	9.4	14.6	9.41	14.6	14.6	
	9.41	4.0	9.	14.5	14.5	0.	9.91	9.6	9.0	14.6	
	9.4	0.	•	4.0	0.4	0.	0.4	14.5	9.4	6.4	
···		0.4	0.4	0.41	0.4	0.4	0.4	14.0	0.4	0.4	
	0 4	0.4		4 4	7	4.4	0 4	9 4 4 1		4.0	
**************************************	0 4	9 4		9,41	9		9.4	14.7	7-41	D • • •	
N'	14.7		14.7	14.7	7.41	7.9	7.4	14.7	14.7	14.7	
031	14.7	14.7	14.7	14.7	14.1	14.7	100	14.7	14.7	14.7	
*** 1,	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	
4	14.7	14.7	14.7	14.7	14./	14.7	14.7	14.7	14.7		
,	14.7	14.	/**!	T. 4. 1	14.7	14.7	7.41	14.7	14.7	14.7	
, ,		14.	7 - 7 -	14.7	7 * 7	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	7 - 4	14.7	14.7	14.7	
* 678	14.7	14.1	14.7	14.7	14:/	1.4.7	~ • • •	14.7	1.5	14.7	
<u>~</u>	14.7	14.1	14.7	14.7	14.8	1 4.8	6.4	14.8	1.1	14.8	
	I. J	14.0	9.4	14.B	14.8	8.4	14.8	14.B	14.8	14.9	
	5 · 4 · ·	5 · 4 · ·	5. d	6.41	7.1	6.4	٥.4	6.4	15.0	0.51	
	5.51 15.3	0.4	10.0	15.0	4.61		4.6	15.6	15.4	7.5	
**	15.9	16.0	10.1	2.01	16.3	4.0		10.0	16.7	16.8	
•	10.9	17.0	17.1	17.2	17.3	7.4	7.5	17.6	17.7	17.1	
	17.8	17.8	17.8	17.9	17.4	17.9	17.9	17.9	17.9	17.9	
	~ 1	5.6	1/•8	17.8	17.H	17.8	9.71	17.8	17.0	17.7	
) •) 1		, , ,		, , , ,	~	0.	9.71	9./1	9./1	
PEAK OUTFLOW	15	495. AT I IME	46.17 HOURS	ćš.				i			
				4-HOUH-9	24-HOUR	72-HUUK	TOTAL	/ULUME			
~		ر د ۲	496	344. 10.	117.	. 58	-	17272.			
		INCHES		2	40	66	:	9			
		E :		12.14	16.28	16.67		16.67			
		AC-F 7		173.	234.	238. 253		23н.			
<i>^</i>				•	• 167			•643			
G				STAT 10	ATION OUTFLO. PLAN		- 210				`
				i de la constanta de la consta			. at an income				Sh. 17
-											
					OUTFLOW						

		1550 1600 1640 1884 2400 3400	153. 166. 186. 185. 232. 334.	158. 167. 183. 225. 321. 370.	165. 180. 219. 310.	213. 248. 368.	176. 204. 365.	203. 203. 270. 363.	
		16.00 10.00 10.00 10.00 10.00 10.00	153. 159. 166. 185. 232.	158. 167. 183. 225.	166. 180. 219. 310.	213.	176. 204. 286.	203.	
	150 156 177 191	153. 160. 164. 188. 240.	153. 159. 166. 185. 232.	158. 167. 183. 225.	165. 180. 219.	203. 173. 213.	176. 204.	203	
	150	153. 160. 164.	153. 159. 166.	158.	165.		176.	. 4/1	
	150	153.	153.	158.	121	4		• 5 5 7	
	150	153	153.		16.7	157.	156.	155.	
	001		* ^ + 7	152.	152.	151.	151.	151.	
	7		7	7 0 4	2 2 3	04	7 7 7	79.7	
	54.	.04.	541	149.	149	691	160.	.641	
	641	149.	149.	150.	150.	150.	150.	150.	
	150	151	151	151	151	151	151	151	
~	15.	151	. 15.1 . 15.1	150.	150°	151	151.	151.	
7	148	147	147.	146.	146.	146.	145.	145.	
	143	143	142.	142.	141	141.	140	140	
1	7	200	139	130	1 39	1.34	138	138.	
-	4.4	1 33	1.38•	1.0% 1.0%	1 0 C	138	138	138.	
-	1.38	. 85. 1. 26.	- 1.44 - 1.44	- F 7	138	, GH .	£ 2	.36.	
- !	138	138.	138.	138.	138.	134.	1 34.	138.	
· ~	138	138.	136.	138.	138.	134.	134.	136.	
	96.	138	138	138	134	134.	134	138	
	136	134.	136.	138.	134.	1.3R.	136.	130	
	138	138.	138.	138.	138.	134.	134.	138.	
7	138	138.		138.	13н.	138.	134.	130.	
			u	CTOUR					
.	450	473	497	2.2	546.	572.	548	624.	
07	_ ,	1107.	74	ر د	1199.	1224.	1246.	1264.	
13	10	1285.	27	S)	1231	1194.	1143.	1076	
⊸ 30	7161	605	476.	* ~	163.	179.	175.	171.	
-	103	65	93.	σο∵.	86.	77.	73.	. 64	
	59	56.	53.	51.	4	46.	. 44	• 7 %	
;	37	36.	35.	34.	33.	32.	30.	24.	
	200	. 92	, c.	. 4.	• m → n	• • • • • •		• · · · · · · · · · · · · · · · · · · ·	
	18	* C	18.		0	ж. С	# :		
	18	•] E	, a ,	18.	19.	.81	19.	
	5 6	- σ	 	20.	.00	, c	• ° ° °	• 500	
	23	23.	3.	W, L	23.		 ဆို	23.	
	22	~	21.	_	20.	20.	.01		
	171	•	15.	i in	14.	13	12.	11.	
	v o	v æ	: .	• •	. .	• .	• •	• (
	Ċ	0	.	.	.	· c	ċ	• •	
	Ċ	•	•	o	c	c	-	, s	
	ć	• •	• •	• 6		• •	• •	• •	
	ć (• 0		• 6	0	0	0.0	0.	
	0	0	•	•		•			
!		0		c	•0	•			
	Ċ C	=	ď	0	00				
	Š	• •	• •	0000					
			200.000.000.000.000.000.000.000.000.000	10.00000000000000000000000000000000000	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	13. 14. 15. 15. 15. 15. 16. 17. 18. 18. 18. 18. 18. 18. 18. 18. 18. 18	10	1

700.00

	14 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	24 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	4.6				
	• • • • • • • • • • • • • • • • • • • •	000000000000000000000000000000000000000	91				
\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$		6 6 5 5 6 9 9 9 9 7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9		14.6	14.6	14.6	
\$ 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	* * * * * * * * * * * * * * * * * * * *	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$			14.6	14.6	
4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4		C C O O O O O P & O	9.		14.6	14.6	
4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	000000000000000000000000000000000000000	9 4	•	14.5	14.6	
0 0 0 0 0 ~ 0 D D D D D D D D D D D D D	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	0 0 0 0 0 0 0 0		•	0 4 4	0.4. 4.4.	
0 0 0 ~ 0 D 5 7 7 0 D D D 7 7 0 - 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	1 4 6 6 6 1 1 1 4 6 6 9 1 1 1 4 6 6 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			0.41	9.4	
0 0 ~ 0 D 5 7 5 0 D D D 7 0 - 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	16.6	41		14.6	14.6	
0 ~ 0 D 5 7 5 0 D D D 7 5 - 4 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	4 4 4 4 4 4	14.0	9.	•	14.5	14.6	
	4444	14.8	.6.		14.6	14=6	
	444	14.9	4.	•	7.4.	14.7	
3 7 3 7 3 3 3 3 3 3 4 3 4 4 4 4 4 4 4 4	4 4 3		91	• •		£ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
2 2 2 2 3 3 3 3 3 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5	4.	14.0	-0		7.41	14.9	
3 4 4 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	-	14.9	• 0	•	14.9	14.0	
9 4 4 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9		1 A . 4.	-8-	.	14.8	14.8	
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	* 4	0.3	7 4		£ 1	B • • •	
15.0	3	4.4			0 4	0 0 0	
15.4	14.	7.71	1		0.31	15.0	
15.1	15.	15.0	•0 15		15.1	15.1	
	15.	15.2	-2.	•	15.3	15.3	
0 1		15.5	9.	•	15.7	15.8	
7.		17.7	- 1		C ~ 0.	7 ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° °	
1	18.	18.4	1		18.4	18.4	
7. H.	# T	18.3	χ	•	18.3	18.2	
7.2	R C	1901	2	•	1.81	18.0	
0.61	• , 1	6.11		•	8./1	B•./	
PEAK OUTFLOW IS 1289. AT TIME 4	44.67 HOURS		;		1		
	· ·	54-	101	4			
(,,	1289. 10	1	154.)			
CMS			• •	1312.			
S TUCAL S	-\;	ľ	┛,	1.75			
T.U. C. W	9 3	7	7 0 0 0 0	F / • # #			
# 00 S00+1	2	612. 774.	787.	787.			
		A S V TO TO THE STATE OF THE ST	-	ţ			
	<u> </u>						
	END-01	-PER10D	HYDROGRAPH UNDINAT	ES	!		
		OUTFLOW					
	•	•0	ļ	•	3	0.	
		ė (!	• 0	0	• 0	
• • • • • • • • • • • • • • • • • • • •	•••	• •	• • • • • • • • • • • • • • • • • • • •	. 0	• • • •	• •	7
	:	0		. 0	; 5	0.	5
	0.0	• 0		•	•	• 0	

1
10
1,
10
1
1
2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
10000000000000000000000000000000000000

	9.41	14.0	14.6	16.6	14.6	14.6	14.6	14.6	14.6	14.6		
ERK OUTFLUE IS 1900 - 10	0.4	0.0	0.4	14.0	0.41	9.4.6		•	9 • • •	9.4.0		
EAC OUT CO. 15. 12. 12. 12. 12. 12. 12. 12. 12. 12. 12	14.0	14.6	14.6	14.6	14.6	14.6			9.41	9.4		
EAR OUTFLUE IS 1900 - 10 - 10 - 10 - 10 - 10 - 10 - 10	14.6	14.6	14.6	14.6	14.6	14.6	•	•	14.6	14.6		
Ext OUTCOM IS 100 100 100 100 100 100 100 100 100 10	14.0	14.0	9.0	14.6	9.9	14.6	•	•	9.	14.6		
EAR OUTFLUE IS THE THE THE THE THE THE THE THE THE THE	c •	0 9	0 9	0.4	14.0	0.4			14.6	14.6		
14.0 15.0	14.7	14.7	7	14.7	14.7	14.7	• •		9 6			
14.0 15.0	14.4	14.0	9.41	14.9	14.9	14.9		•	5.41	14.0		
15.0 15.0	14.0	15.0	15.0	15.0	15.0	15.0	•		15.0	15.0		
15.0 15.0	15.0	15.0	15.0	15.0	15.0	15.0			15.0	15.0		Į
EAK OUTFLUE IS 1964 AT TIME 4 12 12 12 12 12 12 12 12 12 12 12 12 12	15.0	15.0	15.0	15.0	15.0	15.0	•	•	15.0	15.0		
EAK OUTFLUX IS 1964 1570 1570 1570 1570 1570 1570 1570 1570	15.0	0.51	5.0	0.41	0 0	6.0	•	•	6.4	14.9		-
EAK OUTFLUE IS 196.0 15.0 15.0 15.0 15.0 15.0 15.0 15.0 15	1	7 7	, ,	2.6	15.0	. u. u.		•	• 1	• •		
EAK OUTFLUE IS 19-2 15-2 15-2 15-2 15-3 15-3 15-3 15-3 15-3 15-3 15-3 15-3	15.0	15.4	15.0	15.0	15.1	15.1				15.1		
15.4 15.4 15.4 15.5	15.1	15.2	15.2	15.2	15.2	15.2			15.3	15.3		ł
ERK OUTFLUE IS 1944. AT TIME 44-50 HOURS ERK OUTFLUE IS 1944. AT TIME 4	4.61	4.01	4.0.	15.4	15.5	15.5	•	•	15.6	15.6		
19.0 19.1 19.2 19.2 19.5	2,4	7.5	7.4	7.0	2.4	0.07	•	•	16.5	16.3		
EAK OUTFLUX IS 1947 1947 1947 1947 1947 1947 1947 1947	n C	4 ~-		. d	9 4	10.00	•	•	· · · · · ·	* · ·		
EAM OUTFLUE IS 184.2 184.3 184.3 184.5 184	18.7	1 —) ~ .	18.7	18.7	18.7			18.0	D . 0		
14.5 14.4 14.4 18.4 18.3 18.3 18.3 18.2 18.2 18.0	19.7	18.7	13.7	18.6	18.0	14.6			8.5	18.5		
Eak OUFFLOW IS 1942 1941 1941 1941 1940 1940 1940 1940 1940	10.5	18.4	14.4	18.4	18.3	18.3			18.2	18.2		
EAK OUTFLUE IS 1960. AT TIME 44.50 HOURS CFS 1964. 1001. 24-HOUN 72-HOUN TOTAL VOLUME CFS 1964. 1501. 215. 7. 2137 INCLES 56. 2.19 2.85 2.87 TAGUS CU M 570. 1272. 1272. 12822. 12822. 12822. 1282	18.2	19.2	14.1	18.1	18.1	16.1	•	•	18.0	18.0		
THOUS CU M STATION OUTFLO. PLAN 1. HATIO 7 CAS STATION OUTFLO. PLAN 1. HATIO 7 END-OF-PERIOD HYDHOUMAPH UNDINATES 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0		1	PEAK		4	1 1	i 🛏	VOLUME				1
INCRES INCRES THOUSE CU M STATION OUTFLO, PLAN I, HATIO / END-OF-PERIOD HYDROCHAPH UNDINATES OUTFLOW O. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.		2 4 5	1704	1001	010							ı
THOUS CU M STATION OUIFLO. PLAN 1. KATIO 7 END-OF-PERIOD HYDROGRAPH UNDINATES 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0		INCHES AT	•	2.19	2.62	2.87		2.87				
ТНОШЬ СО Н STATION OUIFLO, PLAN I, MATIO 7 END-OF-PERIOU HYDHOGHAPH UHDINATES 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0				1000	100	20.0	:	*0.27				ı
END-OF-PERIOD HYDROUMAPH UNDINATES 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0		JOE		979.	1262.	1039.	;	1739. 1282.				
END-OF-PERIOD HYDROCHAPH UMDINATES 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0				STATIC	OUTFLO.	-	1 011					i
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0				FNO-OF	60181	<u>'</u> 1	: H	! I				ı
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0				,		Ξ,						
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	•0	•0	•0	0.	<u>.</u>	. 0		ć				
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0	•0	0	0	• 0		0		• •	•			
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0	• • • •	• •		• •	• •	0		· c	0	0 0		
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			•	• •	• •	• •		• •	• •	• •		
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	0	0	0	0			• 0	0	0		
0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0		• •	• 6	• •	• •	• 0		ċ	•	ċ		
1. 2. 2. 2. 3. 4. 4. 5. 7. 8. 5. 7. 8. 5. 7. 8. 5. 7. 8. 5. 7. 8. 5. 7. 8. 5. 7. 8. 5. 7. 8. 5. 7. 8. 5. 7. 8. 60. 60.	0		-		-					• c		ļ
11. 12. 14. 16. 14. 20. 21. 24. 26. 37. 37. 36. 37. 57. 59. 60. 60.	• •	0.	· c	• 0	• •	· •		• •	: -:	: -	j	
30, 37, 34, 36, 38, 39, 42, 44, 47 51, 52, 54, 56, 57, 54, 59, 60, 60	-		n. n		3.		4 :	so -		2	Sh. Z	لہ
51. 52. 54. 56. 57. 54. 59. 60.	26.	30.	u n	34.	36.) x •	5	⊸ ∿	• •	. 56.		
	.64	51.	no i	54.	56.	. 7.4	3	, ou				

.

													٠					•																								;	Sh. 12		
59.	• • •	**		١o	7.	38.	79.	• • • • • • • • • • • • • • • • • • • •	5.	•	• •	1.		T	шж. 1.:	T .	s e	er er	34.	Ť			3.	5.	70.	7.	5.			,		7.	0.	1 • 7 ·	2.	•		£	9.		9	ه ه	4	••	
	47.			7	~						1587. 1516.			-	13%. 13	7	•	۰ ا ا	_	- -	7		2.		~ ~	9	65.	***		177.	93.	285. 297.	T	420. 431.	15.	384. 381.		14.0	41	•	•	• •	9	.6	
	67.			73.				437.	846.	265.	1656.	003.		139.	1.4%	138	134.	138.	136.	13 % .		141.	151.	163.	170.	168.	165.	. 104	167	176.	191.	275	378.	425.	*1H.	347.	•	4.6	14.6	14.6	6.5	c • •	14.6	14.6	
61. 55.	, B	• 5 4	4 0	10.	101.	126.	166.	1271.	741	275 275	1737	150		138.	138.	139	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	138.	138.	- MH -	3.5	141.	149	162.	171.	164.	165.	• • •	166.	175.	190.	266.	371.	422 .	421.	390.	• 300	4.	14.6	14.6	4.5	D 0	9.41	14.6	
61.	9	. 44	4 4	67.		123.	165.	1086.	2626.	3274.	1829.	11115.	ų.	~	138.	1 36	 	136.	136.	136.	138	140.	148.	160.	171.	169	166.	104	166.	174.	188.	258.	363.		. 454	392.		7	14.6	14.6	9.41	14.0	14.6	14.0	
61.	49.	45.	4 4	65	46.	120.	162.	870.	2502.	3262.	1925.	1176.	STUMAGE	134.	13A.	1.00 L	138.	138.	138.	138.	96.1	140	147.	154.	171	169.	166.	104	165.	173.	186.	251.	355.	4 14	427.	395.		51A66 14.5	14.6	14.5	9.		14.5	14.6	
61.	50.	, ç,	4 4	62.	26	117.	158.	• +99	2370	3239.	2025.	12.0.		134.	134.	500	96	134.	134.	13%	- F.C.1	139	146.	15A.	171.	169	166.	40.	165.	1711.	185.		345.	4 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	430	300°			•	14.6	٠			•	
51.	. vc	45.	. 44	00	Œ	114.	152.	504.	2230.	3204.	2124.	1306.		134.	134.	200	138.	134.	138.	138.	1	130	145.	157.		130	156.		105	171.	163.	00 V 03 V	334.	405.	432	405.		14.6	14.6	0.4	0.47	0.4	14.6	14.6	
01.	51.	* 3.	44.	5.4.5		112.	147.	364.	20475	3157.	2232	1375.		134.	13A.	4 L		13м.	134.	134	3 2	139.	144.	156.	171.	170.	157.	101	167	170.	182.	- 44. - 33.	322.	1001	434.	405.		14.6	14.6	14.6	2.4.0) ¢	14.0	14.6	
51.	56.	*0	* * *			110	142.	183.	1923	*/ *O *	2337.	1445.		138.	136.	133	38.	138.	134.	138.	133.	134.	143.	154.	171	170.	167.	701	104.	189.	001	226.	304.	345.	436.	・ナウオ		14.6	14.0	14.6	1.00		9.41	14.5	
٠,		 	ر 	1	۱.	· 		<u>-</u>	- 		<u> </u>	ا 	<u> </u>	! 	,. _,!	! 	V \$7		ייננס		ا د د	, C	e P	wac	155)	l Nisr	- 1 3#	l oo <u>r</u>	, ~	. !	•	`		^	1		1	`	_	<u>_</u>		,			

																						52.75
	14.7	15.2	15.2	15.2	15.7	13.6	19.1	28.5 18.5 18.5							•	• -	o o i	0.00	2.	55.	104.	Š
	4 4	15.3	S S S	~~~~	\$ 5	_ =	9 0	00 10 30	i									0	13.	100.	100.	47.
		t to to		ທ່ານ		. 6	55			VULUME 134301.	5.10	2242.			:	::	0 0 1 			43. 96. 113.	115. 110. 103.	٠٢٠
	14.7	15.3	15.2	15.1	15.6	9.4	19.0	19.0		H TUTAL	. .	· ·	HAT10 8	UMDINATES	-	::	• • •		• • • • ~ •	дн. 91. 112.	. 116. . 110. 103.	T
	0.4 4.4		15.2	15.1	15.6	16.8	19.0	16.0		-21	5.10 129.63		PLAN 1.	нтиноснарн		 !				35. 87. 111.	111.	66
	9.4	2.51	15.2	15.2	15.6	16.7	18.9 19.2	18.7		2	5.02		ON OUTFLO.	PERIOD	0.	::	:::		- 0.0	310	116.	6
		15.2							45	5-400H 2731.	3.74	1670.	STATION	FA.0-0F	• 0	ا. د		-0	.0.	77	113.	S
I	14.6	15.2	15.6	15.1 15.2 15.3	15.5	16.5	18.8	18.0	44.50 HOURS	PF AK 3275.	1				• 0	: : <u>:</u> :	:::		0	711.	113.	100
	14.0	15.2	15.2	15.2	15.5	15.4	18.8		. AT TIME	2.42.0 8.43.0	INCHES INCHES INCHES	1-10US CU 4				•	• • •		3.0	105.	116.	1001
	14.5	15.3	15.2	15.1	15.5	16.3	19.2	14.2	15 3275						9	• •			. 0	10.	114.	101
									EAK OUTFLUW													
									Pe											!		

12.0	5.0	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.0	
15.6	15.6	15.6	15.6	15.6	15.6	15.7	15.7	15.7	15.7	
15.7	15.8	15.8	15.8	15.4	15.9	16.0	16.0	16.1	16.1	
~•91 	2.91	. 6.3 	16.4	16.4	16.5	16.6	16.6	16.7	16.8	
200	27.7	2	 X	2.4.	200			V . X	4 4	
18.5	18.7	18.8	18.9	0.51	7.0	19.1	19.2	E 61	1.5	
19.5	10.5	19.7	19. я	19.4	19.9	20.0	20-1	20.1	20.2	
20.5	20.05	20.3	<0.3	20.3	20.3	20.3	20.3	20.3	20.2	
20.2	20.2	40°	~0.7 	20-1	20.02	7.0	19.9	19.3	8.61	
19.0	19.01	16.9	6.81	18.8	18.8	18.7	18.7	18.7	18.6	
A ST LOUTING MADE	TALL AT TIME	64. 44	JA GE							
1			}		:	T	,	-		
			٩	"	72	TOTAL	L VOLUME			
	S F S	CFS 6568.					281955. 7984.			
	130	7 1	001		1	•	272.15			
	AC−1 U⊃ <uo+1< td=""><td>-F1</td><td>25.5</td><td>2715. 3826. 3349. 4719.</td><td></td><td></td><td>3884.</td><td>ļ</td><td></td><td></td></uo+1<>	-F1	25.5	2715. 3826. 3349. 4719.			3884.	ļ		
				STATTON DUTSING DI AN 1	, .		•			
			ń	יאוויסט אוסזואו	OF TEAM 10	7				
				OUTFLOW	3			1		
÷	٠,		-	-1	1	:	•	_	۶.	
∵ ⊓	~ r	. r	.	• °	n n	n n	۰ ۵	∾ໍ່ ຕ	∜ ?	
; ~	i ni			. 2	2	Š		• •	· ~	,
٧.		۶.	~	2.	.,		~		•	
		• -	<u>.</u>	• •	• -	• ·	<u>.</u> .		• -	
	-						: :	 : .:	•	
:	•	.	<u>.</u> .	•	.	:	-	1	•	
-	<u>.</u> .	• 1	-		1 <u>.</u> 2	- a	,	2		
35.	• •		90	. 69	79.	 	• 66	105.	110.	
115.	121.	126.	131.	137.	142.	145.	151.	155.	160.	
191	163.	104	166.	167.	166.	164.	170.	171.	171.	
176.	174.	174.	176.	176.	174.	173.	• • • • • • • • • • • • • • • • • • • •	174	172.	
176.	1.78	172.	1.1.1	17.1	111.	171.	170	170.	170.	
176.	170.	159.	169.	169.	169.	169.	169	164.	164.	
169.		- 120	691	169.	169.	164.	170	170.	.02	
78.	179.	191	183.	199	260.	133.	340.		• • • •	
534	575	614.	651.	6H5	716.	161.	914	R56.	945.	
. 96.6	673	1015.	1001		1147.	1224.	1300.	1381	1473.	
1577	. FOG.	1967.	2002	2228.	2420.	25.59	2872.	3129	3407	Ċ
8199	8710	9242	4764	10256	10726	11166	11570	11665	1>294	72.00
145/0.	12790.	12956.	13070.	13137.	13160.	13139	13070	12950	27	

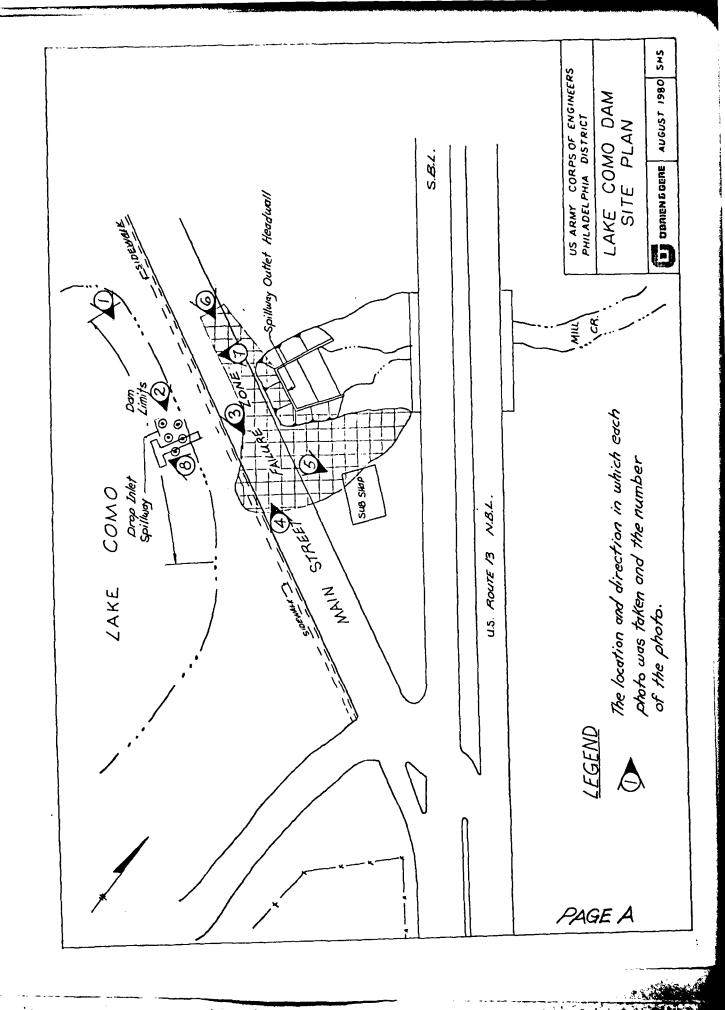
					Ö																														İ			2,0		
																																			ļ	ļ		Ü		
585A. 3445.	139.	136.	139.	139.	139.	138.	140.	156.	245.	275.	279.	272.	269.	292.	333.	356.	***	570.	704	623.	518.	•		0 4	0 0	14.6	9.4	14.6	14.6	0	15.0	15.8	17.1	21.2	17.1	17.0	17.0	17.3	18.2	
6181.	139.	139.	139.	139.	134.	138.	139.	153.	241.	274.	284.	273	269.	288.	324.	354.	435.	555.	7112	634.	528.	•		0 4		•	9.6	. •	•	• •		•			•		•	17.3		
6514. 3950.	134.	134.	139.	139	139.	138.	139.	151.	237.	272.	28¢.	273	270.	286.	326.	356.	426.	541.		645.	537.	• • • • • • • • • • • • • • • • • • • •		0 4	4.	14.6	9 4	14.6	14.6	0 0	14.9	15.6	17.0	17.2	17.1	0.71	17.0	17.2	13.1	
6853. 4036.	139.	134.	1 3 ¢ •	139.	139.	138.	139.		232.	564.	283. 281.	274	270.	263.	322.	350.	41H.	52H.	717	655.	547.	• 00		C 4	9	14.6	9.4	14.6	14.6	0	14.8	15.5	17.0	17.2	17.1	17.0	17.0	17.2	18.1	
7195.	139.	134.	139.	139.	134.	138.	134.	146.	221.	-267	283.	275	270.	281.	318.	34. 355.	414.	515.	716.	665.	557.	• 31.	i			•	9.4		•		•	٠.			•		•	17.1		
7533.	STUMAGE 139.	139.	130.	139.	139.	138	138.	145.	222.	264.	262.	275.	270.	279.	313.	346.	405	502	717	. 7.9	568.	•	STAGE	0 4	14.6	14.6	9.4	14.0	9.4	0 4	•	•		•	•		•	17.1		
7926.	13A.	139.	139.	139.	134.	134	134.	143.	2 H.	260.	281.	276.	270.	277.	304.	362	340.	490.	115	682.	578.	• 0 0	- }		14.5	•	14.5		•	• ' •					•			17.1		
8341.	134.	130	139.	139.	130.	139.	138.	142.	198. 213.	25.7.	, KBO,	277.	271.	276.	303.	. 44.	194.	47A.	213	• • • • • •	569.	• • • • • • • • • • • • • • • • • • • •		t 4	9.	14.0	9.4	9.4	9.41	0.9	14.7	15.4	10.0	17.1	17.2	17.0	17.0	17.1	3.4.	
8743. 5249.	138.	139.	139.	139	130.	986	134.	141	20 X	253	279.	277.	271.	269 . 275.	299	33%	3.00	1.00	970	. 169	600	• 1 6.5	- 1	0 4 4		•	14.0	. •	•	0.4	1001	15.1	19.0	17.1	17.6	17.0	17.0	17.1	14.0	
9190.	134.	139.	139.	139.	134.	139	136.	140.	, 20% 20%	649	. 17.2 28.5	27A.	272.	. 69.	245.	336.	143°	455.	204	703.	511.	. 600	- !	C 4 4	9.41	14.6	14.0	14.6	14.6	9	14.7	15.0	10.1	1:21	17.2	17.0	17.0	17.0	17.9	
												İ																												
			· ¬		0		Ç		0		,	,				•														ļ			, `		,	,		ŗ		•

... _.

APPENDIX

D

Photographs



APPENDIX D

SELECTED PHOTOGRAPHS OF THE SITE

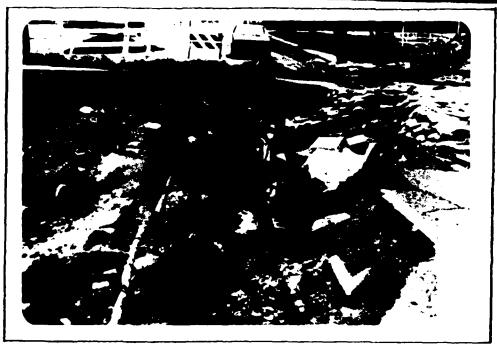
LOC	ATION PLAN	Page No.
Site	Α	
PHO	TOGRAPHS	Page No.
1. 2.	Upstream overview looking towards right abutment. View of multiple drop inlet spillway, access bridge and operators for low-level outlet.	1 1
3.	View showing the zone of failure at the right abutment which was prevented from breaching by sandbagging.	2
4.	View showing failure zone looking towards left abutment.	2
5.	View exhibiting undermining of restaurant downstream of the right abutment.	3
6.	View of failure zone looking towards right abutment.	3
7.	View exhibiting contact between embankment fill on left and natural abutment material on right.	4
8.	Operator for low-level outlet.	4



1. UPSTREAM OVERVIEW LOOKING TOWARDS RIGHT ABUTMENT. (8/12/80)



2. VIEW OF MULTIPLE DROP INLET SPILLWAY, ACCESS BRIDGE AND OPERATORS FOR LOW-LEVEL OUTLET. (8/12/80)



3. VIEW SHOWING THE ZONE OF FAILURE AT THE RIGHT ABUT-MENT WHICH WAS PREVENTED FROM BREACHING BY SAND-BAGGING. (8/12/80)



4. VIEW SHOWING FAILURE ZONE LOOKING TOWARDS LEFT ABUTMENT. NOTE THE RUPTURED 6" WATER AND 4" GAS LINES. (8/12/80)



5. VIEW EXHIBITING UNDERMINING OF RESTAURANT DOWN-STREAM OF THE RIGHT ABUTMENT. AUTO IN LEFT BACKGROUND IS TRAVELING UPON U.S. ROUTE 13. (8/12/80)



6. VIEW OF FAILURE ZONE LOOKING TOWARDS RIGHT ABUT-MENT. AREA OF OVERTOPPING EXTENDED ABOUT 500 FEET TO CEMETARY IN BACKGOUND. (8/12/80)



7. VIEW EXHIBITING CONTACT BETWEEN EMBANKMENT FILL ON LEFT AND NATURAL ABUTMENT MATERIAL ON RIGHT. (8/12/80)



8. OPERATOR FOR LOW-LEVEL OUTLET. (8/12/80)

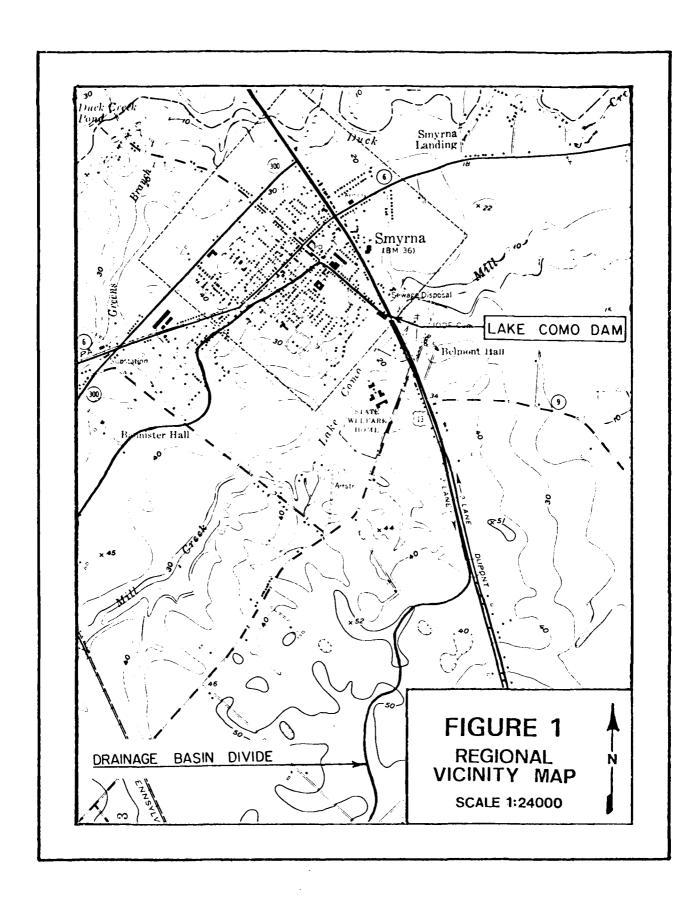
APPENDIX

Ε

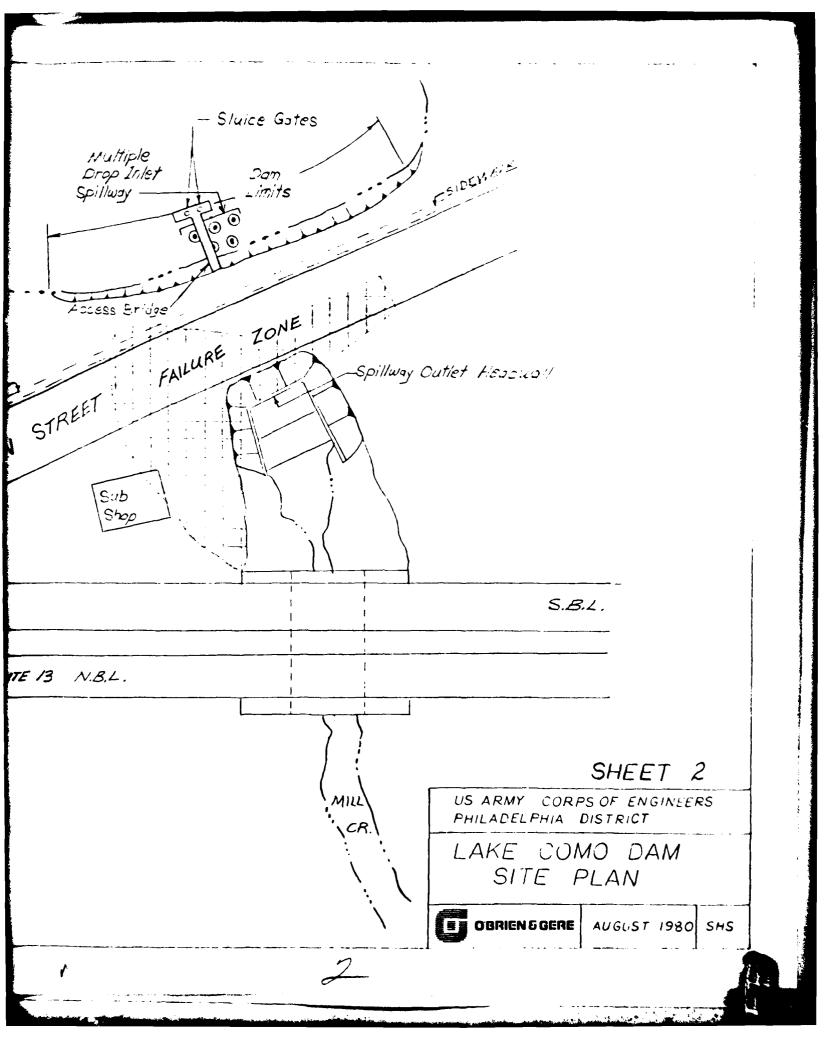
Drawings

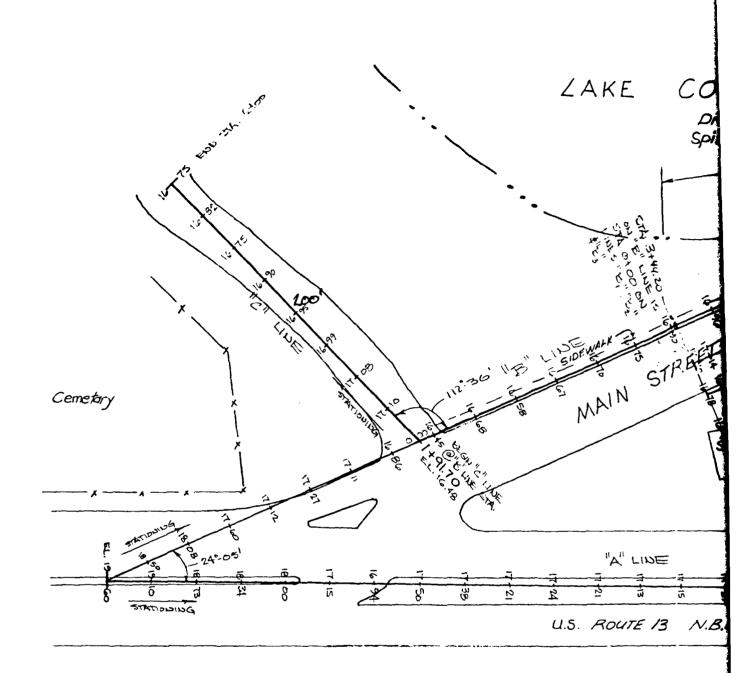


SUBJECT .		SHEET	BY	DATE	JOB NO
LAKE COMO DAM			l		
APPEN	IDIX	E			
TABLE OF	<u>C01</u>	VTE	NTS		
<u>DRAV</u>	VING	<u>s</u>			
		·		· · · · · · · · · · · · · · · · · · ·	
					Sheet No.
Figure 1, Regional	Vicini	41	Map		
Site Plan Showing Fa		-	,		2
Topographic Survey				ailure)	3
March 1941 Site Pla					-
Plan & Section, Inle	•				5
Profile, Drop Inlets			jJ_4_		6
·	-		- 2//		7
Embankment Profile \$					2.0
Teletype Letter fro		•	s ot	Enginee	ers 8-9
to State of De	dud	-0			
					
			····		
	•				
					
		~			



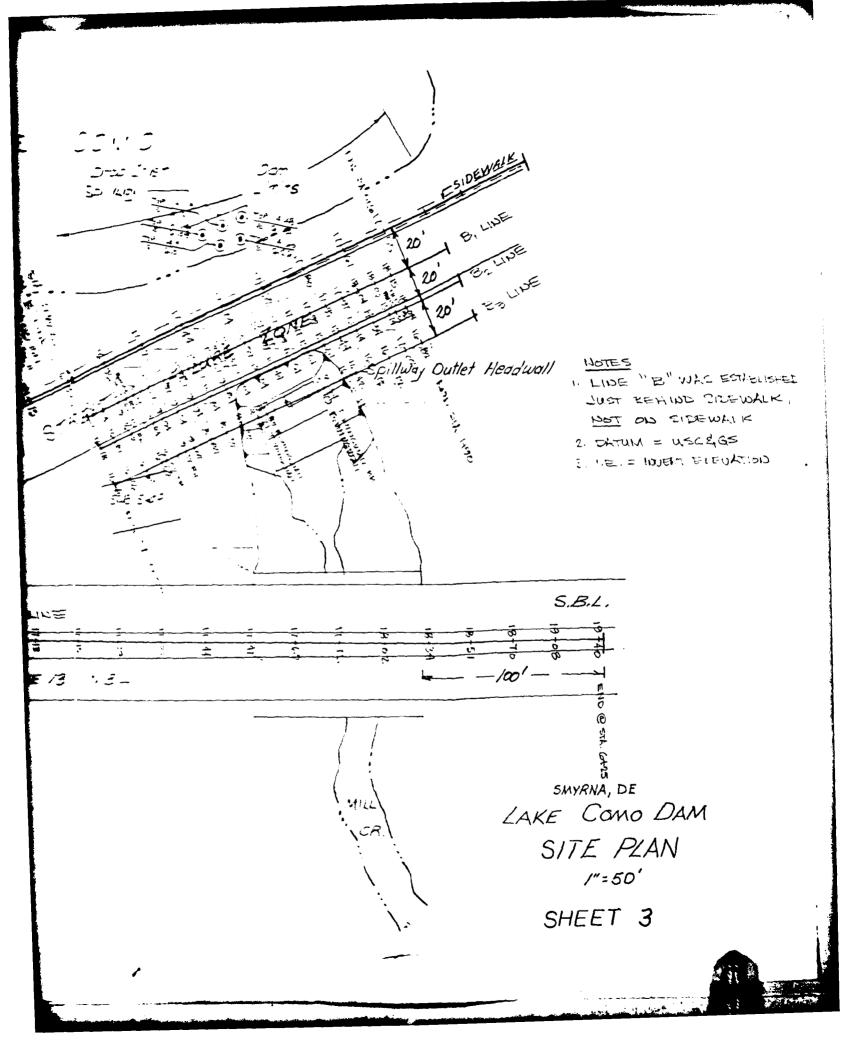
Lake Como MAIN ST Cemetary U.S. ROUTE 13





---- Topographic Survey Lines Elevations @ 25' Intervals

Topographic Survey Lines
Elevs. @ 10' Intervals and at
limits of Sailure zone



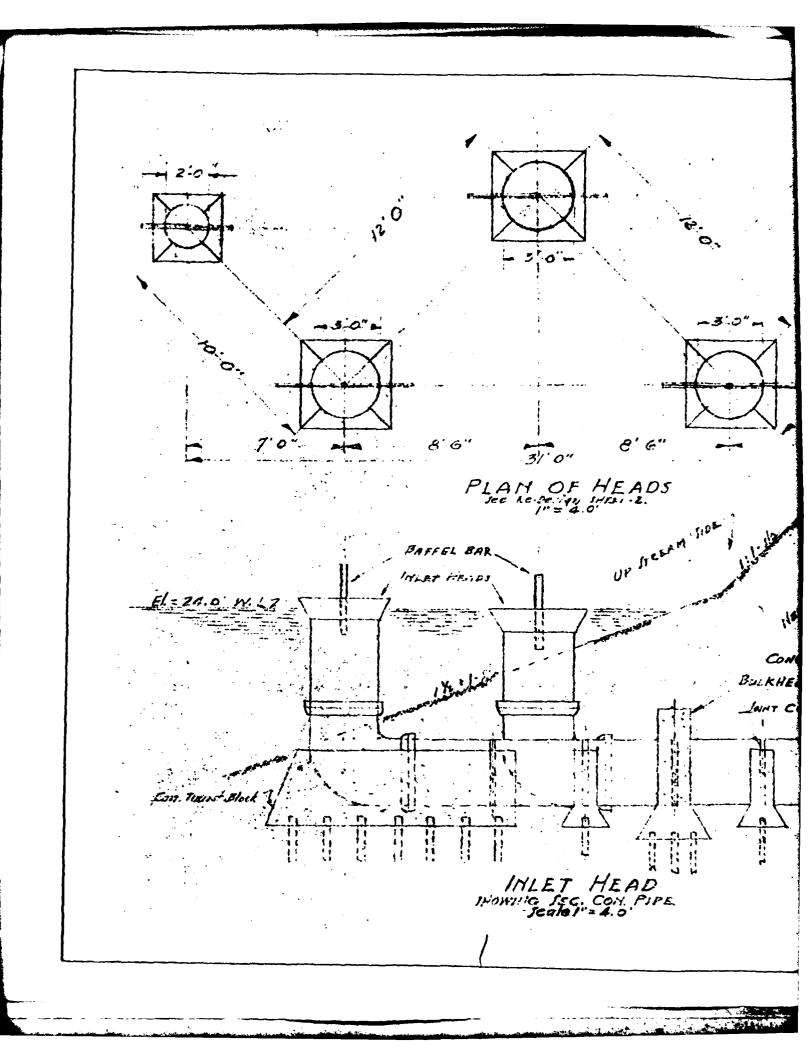
Flats PRESBY TERIAS EMETARY DROP INLET SPILLWAY LAKE COMO DELAWARE: PROJECT - TOWN COMMISSIONERS PLAYGROUND - RECREATION COMM'T. SHEET NO. (1) J. E. HADDAWAY EMGINEER

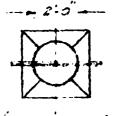
WYOMING, DELAWARE

FROM DESIGNS OF PROF. L. H. KESSLER

UNIVERSITY OF WISC. MARCH - 1941.

SHIONA. Fill MAIN STREET ¢ LAND OF PRIMIZE OWNERS W 2 Carrie Carrie Carrie SHEET 4





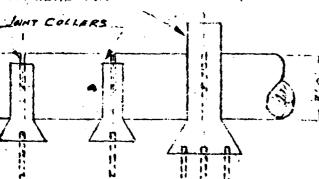
DROP INLET SPILLWAY LAKE COMO

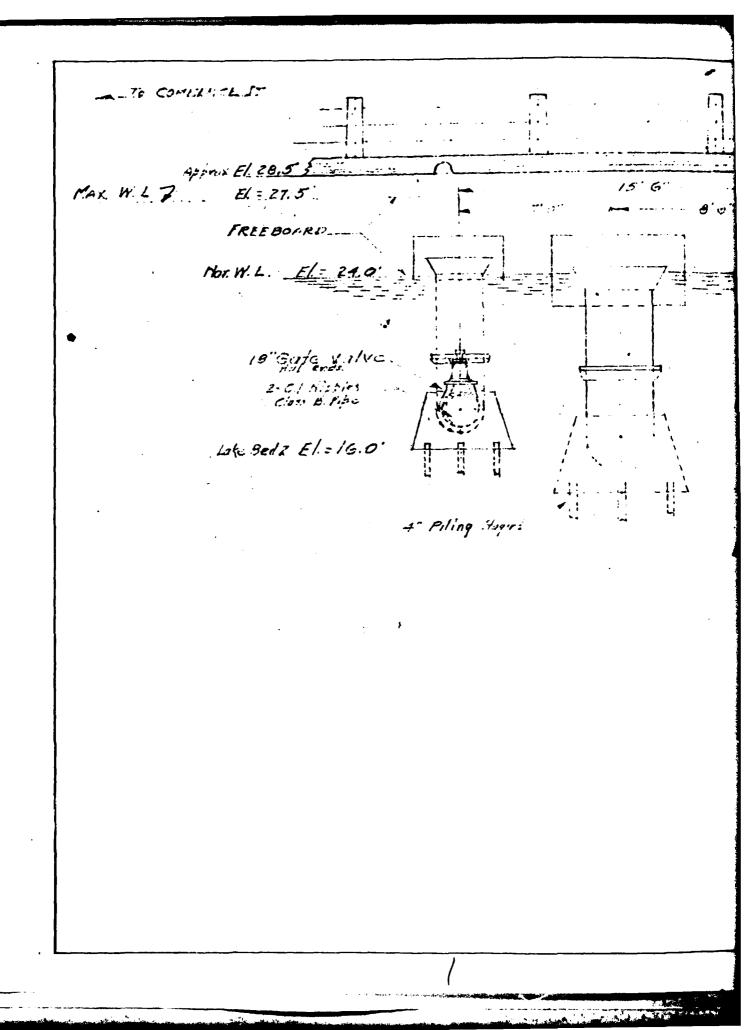
PROJECT - TOWN COMMISSIONERS
PLAYGROUND - RECREATION COMM'T.

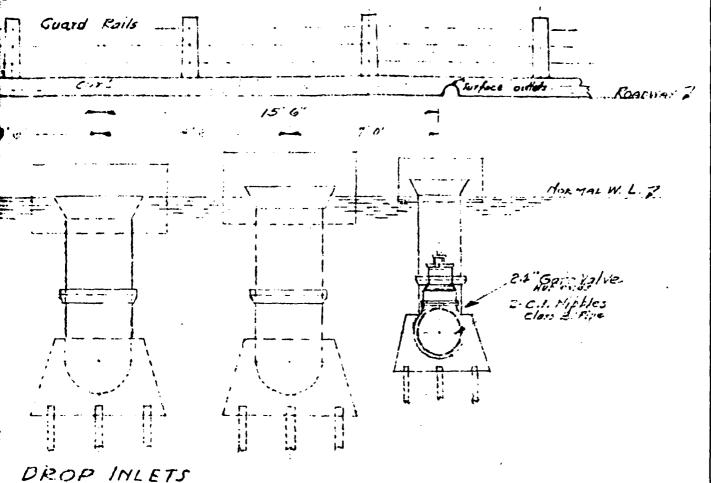
SHEET NO. (1)

J. E. HADDAWAY ENGINEER
WYCMING, DELAWARE
FROM DESIGNS OF PROF. L.H. KESSLER
UNIVERSITY OF WISC.
MARCH-1941.

CONCRETE BULKHEAD FINS





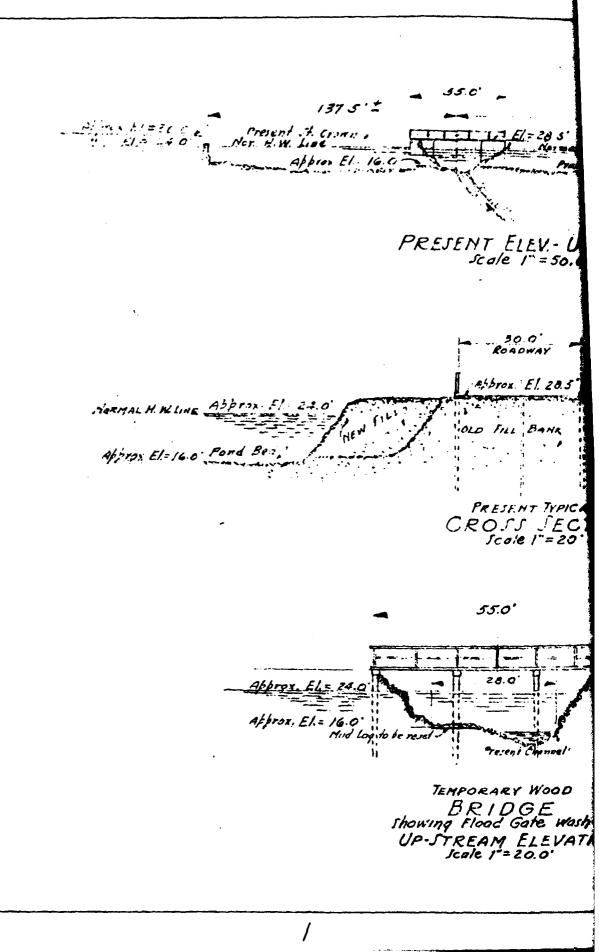


DROP INLETS
FINISHED ELEVATION
SCORE 1: =4.0.
UP-STEEAM SIDE.

DROP INLET SPILLWAY LAKE COMO

SHEET NO. (1)

J.E.HADDAWAY ENGINEER.
WYOMING, DELAWARE.
FROM DESIGNS OF PROF. L.H.KESSLER
UNIVERSITY OF WISC.
MARCH - 1941.



El=205'

More al High Woles of El-24.0'

Present Lake Bed 7

El-24.0'

LEV.- UP STREAM

BANK Warte or Spillway

INT TYPICAL

S SECTION

10 1"=20"

Afrox El. = 28.5;

SHEET NO. (1)

J.E. HADDAWAY ENGINEER

WYCMING, DELAWARE

FROM DESIGNS OF PROF. L.H. KESSLER

UNIVERSITY OF WISC.

MARCH - 1941.

r Wood GE ate Wash-out ELEVATION 10.0'

4-0458065232002 08/19/60 ICS IPMMTZZ CSP PHAB 1 2155974756 MGM TDMT PHILADELPHIA PA 08-19 0355P EST

ARMY CORP OF ENGINEERS J MEEHAN RMD ATTN B HEVERIN CUSTOM HOUSE 2 AND CHESTNUT ST PHILADELPHIA PA 19106

THIS MAILGRAM IS A CONFIRMATION COPY OF THE FOLLOWING MESSAGE:

2155974756 TDMT PHILADELPHIA PA 468 08-19 0355P EST PMS R D BENICK JR DIRECTOR DIV HIGHWAYS RPT DLY MGM, DLR DEPT OF TRANSPORTATION OFFICE OF ADMINISTRATION DUVER DE 99901 SUHJECT LAKE COMO SMYRNA DELAWARE

AT THE REQUEST OF MR KIRSHNA PATEL OF THE DIVISION OF SOIL AND WATER CONSERVATION DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL HEPRESENTATIVES OF THIS OFFICE CONDUCTED A PHASE I INSPECTION OF LAKE COMO DAM IN SMYRNA ON 12 AUGUST 1980 THIS INSPECTION WAS REQUESTED BECAUSE OF THE DAMS CONDITION AS A RESULT OF THE OVERTUPPING WHICH OCCURRED ON 29 JULY 1980 IN RESPONSE TO MR PATEL'S REQUEST WE ARE HEREBY TRANSMITTING PRELIMINARY ENTRANT RECOMMENDATIONS FOR IMMEDIATE REMEDIAL ACTIONS THAT SHOULD BE UNDERTAKEN AT LAKE COMO DAM UNTIL PERMANENT REPAIRS ARE COMPLETED A FOREMAN PHASE 1 INSPECTION REPORT WILL BE ISSUED AT APPROXIMATELY THO (2) MONTHS

- A. AT THE CONCLUSION OF THE VISUAL INSPECTION OF THE DAM WE RECOMMEND THE LAKE HE LOWERED TWO (2) FEET UNTIL REPAIRS ARE COMPLETED WE ARE NOW RECOMMENDING THAT IT BE LOWERED AN ADDITIONAL FOOT TO A TOTAL OF THREE (3) FEET BELOW THE CREST OF THE SPILLWAY PIPE RISERS UNTIL REPAIRS ARE MADE IN ORDER TO INCREASE THE LAKES IMPOUNDING CAPACITY
- B. CONTINUOUS MONITORING OF THE LAKE LEVEL SHOULD BE CONDUCTED DURING PERIODS OF HEAVY PERCIPITATION SO THAT INCREASED IN THE LAKE LEVEL CAN MINIMIZED
- C. THE DAMS OWNERS SHOULD DEVELOP AN EMERGENCY ACTION PLAN DUTLINING ACTIONS TO BE TAKEN BY THE OPERATOR TO MINIMIZE DOWNSTREAM EFFECTS OF AN EMERGENCY AT THE DAM AND A DOWNSTREAM WARNING SYSTEM FOR THE LAKE COMO SUESHOP THE ROUTE 13 HIGHWAY THE SEWAGE PUMPING STATION AND LOCAL EMERGENCY OFFICIALS
- D. THE EMBANKMENT SHOULD BE INSPECTED PERIODICALLY BY AN EXPERIENCED ENGINEER FOR SIGNS OF SEEPAGE OR ADDITIONAL SLOUGHING UNTIL PERMANENT REPAIRS ARE MADE

(

E. USING CORPS OF ENGINEERS SCREANING CRITERIOR THE SPILLWAY IS CONSIDERED INADEQUATE AS A FLOW EQUIVALENT TO 5 PERCENT OF THE ONE HALF PMF OR NINE (9) PERCENT UF THE 100 YEAR FLOOD WOULD CAUSE A DAM TO BE OVERTOPPED THEREFORE THE OWNER SHOULD ENGAGE A QUALIFIED PROFESSIONAL CONSULTANT USING MORE PERCISE METHODS PROCEDURES AND STUDIES TO DETERMINE THE ACTUAL CAPACITY OF THE SPILLWAY AND ANY MITIGATING MEASURES NECESSARY

- F. BURINGS SHOULD BE TAKING THROUGH THE EMBANKMENT AND FOUNDATION TO DETERMINE SUIL TYPES IN-PLACE DENSITIES AND OTHER SOIL PROPERTIES
- G. A DETAILED TOPOGRAPHIC SURVEY OF THE EMBANKMENT FROM THE UPSTREAM SLOPE TO THE ROUTE 13 BRIDGE SHOULD BE MADE
- H. GAS LINES AND WATER LINES SHOULD BE REMOVED FROM THE EMBANKMENT AND RELOCATED
- I. THE DWNERS SHOULD ENGAGE A QUALIFIED PROFESSIONAL CONSULTANT EXPERIENCED IN THE DESIGN AND CONSTRUCTION OF DAMS TO DESIGN AN ADEQUATE EMBANKMENT SECTION FOR THE DAM
- 2. REPRESENTATIVES OF THIS OFFICE ARE AVAILABLE TO DISCUSS POSSIBLE SPILLWAY AND EMBANKMENT REMEDIAL MEASURES AND COST ESTIMATES WITH THE DIVISION OF SCIL AND WATER CONSERVATION DIVISION OF HIGHWAYS AND THE CITY OF SMYRNA UNDER OUR TECHNICAL ASSISTANCE CAPABILITIES AT THEIR CONVENIENCE YOUR COOPERATION IN THIS MATTER IS APPRECIATED JOEL T CALLAHAN LT COL CORP OF ENGINEERS ACTING DISTRICT ENGINEERS CUSTOM HOUSE 2 AND CHESTNUT ST PHILADELPHIA PA 19106

15:56 EST

MGMCOMP

State of Delaware
DELAWARE GEOLOGICAL SURVEY
UNIVERSITY OF DELAWARE
Newark, Delaware
19711

ROBERT R. JORDAN, STATE GEOLOGIST 101 PENNY HALL PHONE: 302-738-2833, 2834

August 15, 1980

Mr. J. J. Schuh, Chief of Design Division of Highways Department of Transportation Administration Center Dover, DE 19901

Dear Jack:

This will confirm our telephone conversation of this morning in which I passed along to you the flow information for Mill Creek for the storm of July 29. The data were provided by the U. S. Geological Survey as part of the stream gaging program in Delaware. The peak flow below the dam at Lake Como was calculated at 2,520 cfs. USGS staff believe this flow may be near, or perhaps exceed, the flow for the statistical 100-year flood. The flow at the first bridge north of Lake Como was estimated at 1,250 cfs. The difference in flow indicates the large amount of rain that fell within the drainage area of the lake proper, exclusive of the inflow from Mill Creek. This agrees with the precipitation maps recently worked up by John Talley of this office.

These figures are provisional subject to complete review by the USGS. However, the staff of the Dover USGS office feels fairly confident of their accuracy.

We are glad to have been of service and know that you will appreciate the rapid response of our federal cooperators in supplying the data you needed.

Sincerely,

Sim Wideliff Kenneth D. Woodbuff Associate Director

KDW:dcw

cc: Art Hodges, USGS

APPENDIX

F

SITE GEOLOGY

SITE GEOLOGY

LAKE COMO DAM

Lake Como Dam is located in the Coastal Plain physiographic province. The Miocene sediments at the site are primarily bluish gray silts with quartz sand and shell beds. The Chesapeake Group sands and silts were deposited during marine submergence of the Delaware Peninsula and attain depths of over 1,000 feet.

